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Protecting Aluminum and Its Alloys from Corrosion

A Report of Opening Meeting of British Electroplating Society

By OUR LONDON CORRESPONDENT

WRITTEN ESPECIALLY FOR THE BRASS WORLD

THE first meeting of the 1929-30 Session of the Electroplaters' and Depositors' Technical Society, was devoted to a discussion on a paper read by H. Sutton, of the Royal Aircraft Establishment. This was entitled "Some Recent Developments in Protective Coatings of Aluminum and its Alloys" and dealt in an interesting way with the latest developments in the production of protective coatings on metals, and more particularly of those methods with which the Author had had personal experience.

The Paper

In regard to the anodic oxidation of aluminum and its alloys, Mr. Sutton said: The anodic oxidation process due to Bengough and his collaborators has been described in several papers, and in a publication of the Department of Scientific and Industrial Research. The process consists in making the article to be treated the anode in a bath of 3 per cent aqueous chromic acid solution, the voltage being raised gradually from zero to 40 volts in 15 minutes, maintained at 40 volts for 35 minutes, raised to 50 volts in the course of 5 minutes and maintained at 50 volts for a further 5 minutes. By this means a protective coating of oxide is produced on all parts of the surface accessible to electrolyte.

Graphite plates have been used extensively as cathodes and in general have given satisfactory service. It has been found possible to use clean steel plates as cathodes, or, where convenient, the tank itself, but stainless steel is preferable to ordinary steel for the purpose. A steel containing 0.10 to 0.15 per cent carbon and 12 to 14 per cent chromium has given the best results as a material for cathodes and tanks. The steel is not an easy one to weld but, by the use of special technique, can be worked up into satisfactory tanks for anodic plant. In the operation of the anodic process there is a tendency for the chromic acid to be reduced at the cathodes and thereby rendered useless. The amount of reduction occurring is influenced greatly by the nature of the cathodes; for example, stainless steel of the type mentioned has been found to cause less reduction than any other material so far employed.

Chlorine and chlorides are very undesirable impurities and have given rise to considerable trouble, due to the fact that they cause breakdown of the anodic film and severe local attack on the aluminum or alloy during treatment in the normal manner. The chloride content of the electrolyte should not be more than the equivalent of 0.02 gram NaCl. per 100 cc. in order to avoid trouble from this cause.

The anodic process can be applied to aluminum, duralumin and most aluminum alloys, but alloys containing more than 5 per cent of copper have not proved capable of being treated. Duralumin, Y alloy and similar alloys can be treated equally well, whether in the final heat treated and aged condition or after softening treatment. Provided that reasonable care be taken to avoid scratching the film, etc., pieces can be heat-treated satisfactorily after anodic treatment, but if a salt bath be used the film is likely to be injured to some extent unless the salt, usually sodium nitrate, is of fairly high purity. There is a marked difference between the appearance of softened duralumin and of heat-treated aged material, after anodic treatment the former being rendered a dark grey compared with the latter. This difference has occasionally proved of service as a method of distinction. Attempts to treat unsuitable alloys are very injurious to the bath since pitting and solution of the aluminum occurs. Contact of aluminum or alloy under treatment with steels prevents normal operation of the process; contact with brass results in rapid and severe attack on the brass during treatment.

The anodic oxidation process tends to open up and reveal clearly any defects such as laps, seams, etc., in the metal occurring at the surface, also to disclose any attempts to plug up blow holes, holes drilled in the wrong place, etc.

The protection against corrosion afforded by anodic

films is much improved by the subsequent application of suitable paints or enamel, or by a grease. Lanolin has been much used for the purpose, and is probably applied most conveniently in the form of a solution consisting of white spirit 45 per cent, solvent naptha 45 per cent, lanolin 10 per cent by volume.

The Jirotka Process.—This process consists in obtaining a protective film on the surface of aluminum and certain alloys by immersion in a bath consisting of an aqueous solution of suitable salts, notably chromates and salts of the heavy metals, kept at a moderate temperature. The treatment affords considerable protection against corrosion. A very interesting aspect of this process is the variation in colour of the films obtainable, suggesting considerable scope for the process in decorative work.

The Stafford O'Brien Process.—Precise details are not available, but the process is stated to consist of anodic treatment at low voltage in sulphuric acid containing a chloride, and is a method of producing films on aluminum and aluminum alloys for protection against corrosion. It is claimed that the process is effective on aluminum alloys, including the high copper-alloys.

Coatings of Metallic Aluminum.—A form of duralumin having a coating of aluminum of high purity, and known as Alclad, is being produced, the object of the coating of pure aluminum being to protect the underlying duralumin from corrosion. The coating is understood to be applied by means of a special casting process, and not to the sheet as such. The makers claim that the attack by a corroding agent at cut edges is borne by the metal of the coating, and not by the duralumin.

The protective effect of treatments of the "calorizing" type on steel is well known. "Calorizing" consists in packing the pieces in a mixture of aluminum powder, aluminum oxide, etc., and heating for a period of some hours. As a result of the treatment aluminum is absorbed by the steel near the surface, and the aluminum-rich layer at the surface has the effect of rendering the steel particularly resistant to oxidation when heated in air.

Another way of applying aluminum to steel is to electrodeposit a thin coating of cadmium on the steel. which is then preheated slightly and dipped in a bath of molten aluminum. The cadmium coating presumably melts and vaporises, permitting access of the molten aluminum to the steel in the absence of air. When the steel article is removed from the bath it has a coating of aluminum resembling that of tin or zinc on work removed from hot-tinning or hot-galvanizing baths. The aluminum coated iron is very resistant to oxidation at elevated temperatures, and to corrosion at normal temperatures, as mentioned by Evans.

Electrodeposits on Aluminum.—Nickel deposits on aluminum have proved capable of affording a fair degree of protection against corrosion, but the protection afforded is dependent upon the physical character of the deposit, since any discontinuities in the coating form seats of corrosion of the underlying aluminum. Brook and Stott observed moderate resistance to corrosion of aluminum samples having nickel electrodeposits of about 0.0001 inch to 0.001 inch thickness. H. K. Work has described methods of producing a roughened surface on aluminum and aluminum alloys by the use of etching solutions. His objections to sand-blasting is the equipment required. His nickel plated samples bearing 0.0005 inch of nickel alone appear to have given fair results in a salt solution test, i.e., partial immersion in 1 per cent NaCl.; 1 per cent $CaCl_2$ solution.

Cournot and Bary made corrosion tests by partial immersion in an artificial sea water, and nickel deposits on aluminum gave fairly good results. It is generally agreed that for reasonable protection of aluminum and aluminum alloys, nickel deposits require to be free from pores and of moderate thickness. Practical experience of duralumin and aluminum plated with nickel has shown that unless the nickel deposit is moderately thick, i.e., 0.0005 inch or more, and substantially free from pin-holes the deposit may be expected to blister and to become disrupted in places.

Zinc deposits on aluminum and aluminum alloys have given promising results, and afford better protection than nickel deposits under severe conditions. In the author's laboratory sand-blasting with fine sand has been found the most consistent and generally satisfactory method of preparing the work. Deposits from sulphate and cyanide zinc baths are being investigated for general and protective properties. At present the sulphate type of bath appears to be preferable to the cyanide type since a higher degree of protection is obtainable by the former, when used with appropriate addition agents.

Cadmium deposits on aluminum and aluminum alloys have given promising results. Cournot considered the cyanide type of bath the best for the purpose, and obtained satisfactory results in corrosion tests. He has also reported favorably on deposits of chromium on cadmium as a protection against corrosion. In the author's laboratory cadmium deposits have given good results, particularly on aluminum alloys. Although, under marine conditions, the cadmium of the coating appears to be removed rather quickly, it appears to leave a protective coating, probably consisting of mixed oxides of cadmium and aluminum.

The research at the Royal Aircraft Establishment on the use of electrodeposited coatings for protection of metals against corrosion is now receiving assistance from the Department of Scientific and Industrial Research, and special investigations are in hand for the Electrodeposition Committee of the Department.

Discussion.

The Chairman (U. R. Evans) said the properties of the light alloys were bound up with the invisible surface film, which Mr. Sutton had been the first to isolate, and the study of this film was therefore of great importance. Attempts to plate upon aluminum and its alloys formed an interesting study since the difficulties in plating upon other metals were magnified or "caricatured" resulting in valuable information. With regard to coating steel with aluminum to prevent corrosion, results had been most promising in a comparison which he had carried out between the efficiency of various finishes. There was a big future for aluminum coatings if their performance was satisfactory, and costs not abnormally high.

E. A. Ollard said he was interested to hear from the Chairman that Mr. Sutton had been the first recently to isolate the oxide film. Actually, when he was in Berlin in 1924, Dr. Leibreich had shown him a photograph of an aluminum electrode taken at the moment of the reversal of the current—this clearly showed the oxide film curling away from the surface. He thought Mr. Sutton's notes on plant used in the anodic process would be particularly interesting to the practical chromium plater, who met similar difficulties. In regard to depositing upon aluminum.

Prof. Desch had obtained good deposits of cadmium using a sulphate solution. Did the same apply to zinc?

Dr. R. S. Hutton, the president, said although the idea of anodic oxidation was not new, e.g., the aluminum rectifier had been known some 20 years ago, yet the idea had been lying dormant until Bengough and his colleagues at the Air Ministry had worked upon it and brought it to the point of commercial application. There was a very big potential field for the process and licenses to work the process were now being issued to manufacturers—chiefly in the aircraft industry by the Department for Scientific and Industrial Research. There was also a big future for aluminum coatings, although an electrodeposit which was much thinner, might give as good and even superior results.

D. J. MacNaughtan, referring to the practical difficulties in anodic oxidation, said it was essential that no other metal be in contact with the aluminum being treated. Such articles had to be disassembled, then reassembled after oxidation, injury to the film being then prone to occur. There was also the difficulty of suspending the article. Also the appearance of the finish on certain alloys, such as duralumin after heat-treatment, was unsatisfactory, showing up the crystal structure. Did this affect the corrosion resistance? Very good deposits upon aluminum had been applied from time to time; the difficulty was to find a reliable process which would give, say, 90 per cent satisfactory results.

J. W. Perring said that the variation in voltage could be carried out smoothly by means of one of the variable speed gears on the market. With regard to the breakdown of the film due to excessive voltage, the same occurred in the Nodon valve consisting of aluminum in tri-sodium phosphate solution, where if the voltage were high, sparks could be seen, the site of which showed pits in the aluminum. With this valve using tantalum in magnesium sulphate solution, the anodic film could be seen to flake away.

S. E. Weill said the anodic process could now be satisfactorily worked on, both aluminum and duralumin. Colored finishes could be obtained afterwards without difficulty and there was no difficulty with the generator. The solution was so cheap that it was best to scrap it periodically. Work should be suspended by aluminum wires secured tightly. The big difficulty in plating upon aluminum was that the latter oxidized so readily.

S. Wernick (Honorary Secretary) said there was no doubt about the efficiency of the anodic process as a method for protecting aluminum. It did not however seem necessary to carry out the step-up in voltage in the exact manner suggested since he had obtained good results using fewer stages of voltage adjustment and less time in the bath. With regard to nickel plating upon aluminum, he had examined a number of advocated methods some five years ago, but no method gave absolutely satisfactory results. After outlining his experience with these methods, Mr. Wernick said the most promising method made use of an initial coat of iron obtained by a dip in an iron salt, and an aluminum article plated over five years ago had withstood very well the atmosphere of a laboratory and had subsequently behaved very satisfactorily in the salt spray chamber.

Mr. Sutton then replied to the discussion and was accorded a hearty vote of thanks for his interesting paper.

Iron Plating Solution

Q.—Please give me a formula for an iron plating solution. I am plating flat plates about 4 inches square.

A.—The following iron solution will give good results if operated under proper conditions:

Ferrous chloride	16 oz.
Calcium chloride (anhydrous)	16 oz.
Water	1 gallon

Anodes of pure iron should be used. Temperature should be 175° F., and cathode current density 20 amperes per square foot. The current density may be increased to 100 amperes per square foot and the temperature to 195° F. if it seems advisable.

—Oliver J. Sizelove.

Strength Tester for Cleaners

Apothecaries Hall Company, Waterbury, Conn., manufacturers of various chemical products used in the electroplating and finishing industries, announce an improved means of testing cleaning solutions for strength and cleaning properties. The material, known as "Ahco" cleaner pellets, according to the makers, will show the strength of a metal cleaning solution if dissolved in a small sample of the solution. While the pellets cannot improve the solution, the makers state, it does indicate its strength and cleansing capacity to a degree making it a very practical and efficient test method for general shop work.

The company markets the pellets separately or in the form of a test set consisting of a supply of pellets and 250 c. c. beaker and glass stirring rod. This is all the apparatus needed.

Gold Strip Analyzed

Q.—Am sending you a sample of a gold stripping solution which I would like to have analyzed. It was made up by a man working here previously and I would like to know the formula.

A.—It is quite a difficult task to completely analyze the sample of gold strip and to give the original formula.

Analysis shows it contains a large quantity of sodium cyanide, some chlorides, phosphates, and iron.

A strip made from the following formula will give equally good results:

Sodium cyanide	8 oz.
Yellow prussiate potash	2 oz.
Rochelle salts	2 oz.
Water	1 gallon

Use lead anodes; temperature, 175° F.; 6 volts.

—Oliver J. Sizelove.

Reclaiming Battery Lead

Q.—We are interested in compiling data relative to the recovery of lead from battery plates. We are using as a basis 800 tons of lead battery plates per month. Can you furnish us with the cost of a plant for this operation, together with the cost of recovering the lead?

A.—The proper method of recovering lead from bat-

tery plates is by blast furnace. These furnaces can be had in several sizes, and we suggest you get in touch with manufacturers of blast furnaces for further information.

With proper equipment, the cost of recovery should not exceed $5.00 per ton. It is necessary to understand the proper fluxing to run the furnace successfully. In a general way, the proper flux is iron scale and galena ore, lime, fluorspar, coal dust and silica. We suggest that if you go into this business you secure a man familiar with this class of work to start your furnace. We believe you will save considerable by procuring the proper man to install your furnace.

There are other methods of reclaiming battery lead. The blast furnace method, however, is the cheapest and best.

—W. J. Reardon.

Refining Solder Dross

Q.—Will you kindly advise if you have any information on how to run a solder dross containing approximately 60 to 65 per cent metallics that analyzes 4 per cent copper, 35 per cent tin, ½ to 1 per cent antimony, balance lead?

When running this metal into our regular dross furnace starting with a 4 per cent copper, we have, when finished, a 6 per cent copper mixture, and when refining this in a pot it naturally gives us excessive dross, which it is necessary to refine again. We wonder whether there is a possibility of reducing this copper during the first melting and creating a matte from the start? What fluxes are used?

A.—We suggest you try a flux composed of:

Galena ore (a sulphur ore)	100 lbs.
Iron scale	100 lbs.
Soda ash	15 lbs.
Silica sand	75 lbs.
Coal dust	200 lbs.
Lime	50 lbs.

Use from 10 per cent to 20 per cent of this mixture in your first melting. This flux should form a matte and take out the copper and throw the tin and lead to the bottom. It may be necessary, if you find the copper is still in the tin and lead, to add more galena ore to the mixture of flux. Such a mixture gives good results in removing the copper. The copper goes after the sulphur and is run off in the slag, and the iron throws the tin and lead to the bottom.

—W. J. Reardon.

Alloying Copper and Aluminum

Q.—Can you give us information in regard to melting copper and aluminum so that it will not make a slag but a clean melt?

Would also like to get information in regard to drawing pure nickel. This seems to drag on the draw tools and cling to them. Is there anything you know of which would overcome this?

A.—By "melting copper and aluminum" we assume you mean making an alloy of copper and aluminum. The method we would suggest is to use electro-copper and virgin aluminum. Melt the copper first. Just as the copper melts, add the aluminum, stirring well, add a handful of salt, and bring the metal to pouring temperature. There are a number of fluxes used for this alloy that give good results. If you desire, the names of them will be sent you. However, you will find very little slag if you use the method above, and this should be what you desire.

In reference to drawing pure nickel, we suggest you try lard oil.

—W. J. Reardon.

Furnaces for Zinc Metallics

Q.—We manufacture melting equipment and have a client who now is using iron pots in running down impure zinc metallics, and who wishes to know which of our furnaces to use. They mentioned a reverberatory but we suggested a tilting crucible furnace with cover over crucible as well as over the furnace, or an iron pot tilting furnace. They say that their loss in oxide is about ½ at present.

Their metallics are impure, that they oftentimes remove skimmings, which is oxide, equal to tonnage of pig metal produced; and their best results are obtained in bath of metal and working the new charge into it.

The customer advises that the metallics that they charge into a furnace is a product which has adhering to it metallic particles, some oxide, and other impurities such as chlorine, silica and some tramp metals. They would not wish to convey that the skimmings or loss of metal in the melting was formed during the melting, although some zinc is converted to oxide in their present practice.

They would be interested in data in regard to use of a reverberatory furnace. They refer to a reverberatory where tonnage of 10 to 25 tons of slabs is desired. What is your recommendation?

A.—There is no better method of running down zinc scrap than the iron pot. This can be the stationary or tilting type.

However, this method will not reduce oxide of zinc. Only free zinc will be recovered by the iron pot method. For zinc ashes and skimmings containing considerable amounts of oxide and zinc dust, the retort furnace is the furnace to reduce such metal. For sal ammoniac skimmings, zinc ash and zinc dross we would not recommend a reverberatory furnace. However, there was a furnace that looked good to me for this work published in Brass World for December, 1907, by Edgar F. Blessing. Look this up. It may interest you. Also, a furnace, Patent No. 932279, described in The Metal Industry of October, 1909. Also, a patent furnace, Patent No. 910982, described in Brass World of February, 1909. The zinc retort you can see in any zinc works, or you will find a description at the library.

—W. J. Reardon.

Sweating in Bronze Castings

Q.—We are experiencing considerable difficulty of late in the final finish of our ornamental castings, whether in brass, bronze or extruded metal mixtures.

The patterns are all molded in French sand from combined wood and wax and plaster patterns and occasionally hard black wax patterns. The work is mainly faced and double faced work, skin dried and oven dried; and the metal used is a standard ornamental bronze mixture of 86 copper, 3 tin, 2 lead and 9 zinc.

Our trouble consists of small "pimples" on the surface of the casting which show only when the work is either highly polished or finally colored in statuary bronze. We have changed our methods in an effort to eliminate these but do not seem to be successful.

We should be glad to have you advise us as to the causes of this condition.

A.—We are of the opinion that your trouble is in

the metal and is caused by what we call "sweat." We would suggest that you try adding 1 per cent of 50 copper—50 nickel alloy. This will help the metal to set quicker and also will help to eliminate sweating or segregation.

—W. J. Reardon.

Casting Monel Metal

Q.—I am writing you to ask if you can give me some information on casting Monel metal. I have been casting some pieces but they all break in half or crack in several places. They are chased patterns with figures on. I also would like to know what kind of sand to use. Is it necessary to dry the mold?

A.—In making Monel metal castings the best results are obtained by using new metal shot. Use No. 60 crucible and, if possible, use the oil or gas fired furnace. Place all the metal in crucible. Use a little borax for a flux. Heat quickly. Gate similar to gating manganese bronze. Pour quickly.

Use a facing sand composed of the following: 12 shovels molding sand, 3 shovels of new silica sand, ½ shovel of pitch compound, ½ shovel of flour, 1½ shovels of fire clay. Mix this thoroughly and stamp. Skim-dry molds with blow torch for small work.

Close mold and pour as soon as closed. Just before pouring, add 3 oz. magnesium to the metal as a flux. Tie the magnesium to the end of an iron rod with copper wire and insert to the bottom of the crucible. Also use 2 oz. aluminum inserted in the same way. This will quiet the metal, and if used as suggested should give good results.

In reference to cracking of casting: heavy sections not provided with a riser or feeder will tear or crack away as the thin section in cooling or freezing draws from the heavy section. Hence it is desirable to place risers on heavy part to feed while cooling. For your class of work I would suggest a number of gates into the casting.

—W. J. Reardon.

Casting Brass Slabs

Q.—I would appreciate very much your advice, in the following problems:

What dressing should be used in pouring brasses with over 80 per cent copper, balance zinc? What is the best pouring temperature? Do such alloys need a specially dimensioned mold? Is a deoxidizer advisable?

Our cast iron molds vary in section, width and length and we have the most trouble for the wide ones. The defects are in form of small to thumb-deep holes, located through all our slabs, a little more in the center of the section than at the edge parts. Such holes are always filled with a carbon deposit.

We melt our metal with great care, use the well known lampblack-kerosene-lardoil dressing, and pour through runner boxes. Small amounts of a deoxidizer are added to the brass. The slabs are 75 x 9¼ x 1⅛ inches in size.

A.—A slab with the dimensions you give is very hard to cast without carbon holes. The dressing you are using is customary for such work. We would suggest that you try acetylene gas as a dressing. Secure a tank of this gas, light the pipes and apply the smoke. This has been found satisfactory for such work. If you have any trouble with the smoke not holding, spray the mold with silicate of soda before applying the gas. The first casting may not be so nice but after that they should come smooth and clean. The silicate of soda is applied only for the first casting.

—W. J. Reardon.

Brass Type

Q.—We are interested in finding a substitute for brass type. Kindly let us know the melting point of aluminum bronze; that is, the pouring point; whether the contraction in cooling will be too great to give satisfactory results; and whether machines like the Monotype or Ludlow will do this kind of work. The Ludlow, and we believe the Monotype, use brass matrices. Let us know how this alloy compares in hardness with ordinary yellow brass, such as used in brass type. If you have no information concerning these casting machines, give us the other information and we can then take the matter up with the manufacturers.

A.—The melting point of aluminum bronze is approximately 1650° Fahrenheit. The pouring temperature would be approximately 1950 to 2150° Fahrenheit.

We have no information in reference to casting brass in machines like the Monotype or Ludlow. The only information we have on this class of work is the electric type method; that is, the letters are formed in wax and electroplated and are sometimes called matrices. The letters are then backed up with a white metal.

However, aluminum bronze casts in metal mold readily and will cast in letters. The only method we know of is permanent molds that are poured by hand. We have no information on pouring under pressure.

—W. J. Reardon.

Cleaning Castings

Q.—Would you kindly advise me how to clean dirt off brass. We have great difficulty in cleaning and that is the reason we do not get very good castings. We have tried it for six months and some times it comes out good, while other times it is very poor. If we overcome this difficulty we can have good castings and business will be successful.

A.—The best method of cleaning brass castings is the sand blast, which cleans the casting thoroughly, removes all sand and leaves them smooth.

Another method is to water tumble; that is, to secure a water tumbling barrel from any of the foundry supply dealers and put castings in barrel with slag and skimmings. It will clean and scour and brighten up your castings. The sand blast, however, will do the best job.

Another method is the wire brush that can be put on the emery wheel. The casting is held against the wheel. Such a wheel can be had from any foundry supply house.

—W. J. Reardon.

Molding Sand

Q.—We understand that the statuary bronze foundries use some white preparation instead of sand, which produces very smooth bronze castings and we would like to have you advise us whatever you may know of this and where it can be bought so that we can see whether it could be used in commercial work.

A.—We have no information on any white preparation being used by statuary brass foundries instead of sand that produces very smooth bronze castings. The only method we know of is a mixture of French molding sand and Windsor Lock, approximately 50-50, and dried and sieved through a No. 20 mesh riddle, tempered and rolled.

—W. J. Reardon.

Testing Quality of Deposits

Q.—We have been asked to submit certain data to an organization and will very much appreciate any assistance you can give us.

This concern purchases novelties finished in gold and silver plate, and they are anxious to have the proper standard in reference to these finishes, and a method whereby they can test to see if they are getting what they specify. They are interested in Roman finish, 14 kt., 18 kt., and 24 kt., gold plate, as well as silver plate.

How can we, as the plater, determine how much gold or silver plate we are placing on the article? Is this done through the length of time the article is in the plating vat, or must the article be submerged several times so as to build up layers? Or does the voltage regulate it?

After our customers adopt what they consider a suitable plate, they want to know how to test the articles to see if they are getting that quality. What is the test?

A.—The most practical method of depositing silver and gold upon articles by weight is to do so through the use of "Sangamo" ampere meters. This is done by first determining how much of the precious metal you wish upon a gross or any predetermined amount of the articles to be plated. The meter is set for this amount in ounces, pennyweights or grains, as the case may be, and when the deposition is complete, it is signalled through the use of an electric bell or light. The amount deposited upon the entire batch is correct as set, but will vary slightly on each individual piece. For example, if upon 100 articles a total of 100 dwt. of gold is deposited, the average should be 1 dwt. per piece, but actually some pieces will have slightly more than 1 dwt. and others a little less. This is due to electrical distribution of lines of force within the tank and cannot be entirely eliminated, although it can be more or less controlled. For a "Sangamo" ampere meter, write the Sangamo Electric Company, Springfield, Ill.

To determine the amount that is deposited, strip plate from a given number of the articles and then determine the amount by the usual chemical methods. But bear in mind that the amounts deposited upon the individual pieces will vary, as explained above.

—Joseph Haas.

Cadmium and Copper Solutions

Q.—I am using nickel and copper plate to protect knives of large size. This does not seem to be satisfactory. Do you know of any way to make the knives rustproof?

What is the best copper solution for plating on lead?

A.—To protect the knives from rusting, we suggest that you cadmium plate them instead of nickel and copper plating. Use the following solution:

Cadmium oxide	3 oz.
Sodium cyanide	9 oz.
Caustic soda	2 oz.
Water	1 gal.

Use at 80° F.; cathode current density, 15 to 20 amperes per square foot.

Formula for copper solution:

Copper cyanide	3 oz.
Sodium cyanide	3½ oz.
Carbonate soda	2 oz.
Hyposulphite soda	1/64 oz.
Water	1 gal.

Operate solution at 110° F., with a cathode current density of 3 to 4 amperes per square foot.

—Oliver J. Sizelove.

Nickel Plating Data

We are sending a bottle of nickel plating solution and a sample of plating which is not right.

Plating solution formula is not known as we no longer employ the foreman who made it. Plating from this solution comes out with black blotches and streaks, especially in corners.

Temperature of tank is approximbately 75 deg. F. Work is plated at 4 volts, but amps per square foot we do not know. Anodes are nickel. Tank capacity, 800 gallons; semi-automatic plating. Ordinary buffed finish is required.

Parts plated and process: The steel rod is first barrel plated with nickel. The rod is then fastened into the knob. Knob is die cast, zinc base. Then the rod and knob assembly (knob being first polished) are plated in the above tank.

We found a large accumulation of knob and rod assemblies in the bottom of the plating tank and the die cast knobs were badly eaten away. This scrap was cleaned out. The plating foreman then added some ammonia, also slight amounts of sulphuric acid, but owing to lack of information as to solution formula he did not add very much of either. We finally found a plating employee who made some additions to the solution that brought the plated articles out of the solution in good shape. The reconditioned solution is the sample sent you. As we do not know what solution formula we are using and what was the probable difficulty and its remedy, we are asking you to tell us. We believe sodium chloride, sodium citrate and ammonia were the additions used to bring solution up to standard.

A.—Analysis of nickel solution:

Metallic nickel	2.53 oz.
Chlorides	1.62 oz.
Metallic zinc	.12 oz.
pH	5.4

The nickel content of the solution is about right and would represent a solution composed of 10 ozs. of double nickel salts and 5 ozs. of single nickel salts per gallon.

The chloride content is low; so is the pH. Would suggest that you add 150 lbs. of sodium chloride and 50 ozs. of 26° ammonium hydroxide to the 800 gallons of solution.

The zinc content is quite high and is due to the die cast pieces that were allowed to remain in the bottom of the tank. The zinc that the solution contains is the cause of the black streaks on the deposit and there is no way of successfully removing the zinc.

Your employee undoubtedly added sodium chloride, sodium citrate and ammonia to the solution, and analysis shows that he has not added enough.

The following formula is used to nickel plate die cast work:

Double nickel salts	10 oz.
Sodium chloride	7 oz.
Boric acid	2 oz.
Sodium citrate	1 oz.
Water	1 gallon

—Oliver J. Sizelove.

Scientific Plating Control

Q.—I would like to know where I can get information on the scientific control of plating baths. Perhaps you can recommend a good book on electrochemistry, etc.

A.—We can recommend "Principles of Electroplating and Electroforming," by Blum and Hogaboom, procurable from Brass World.

—Editor.

Accelerated Corrosion Tests for Coatings of the Iron Phosphate Type

The Salt Spray Test, and Intermittent Immersion Tests in Distilled Water and 0.01 Normal Sulfuric Acid Were Found to Be Suitable for Evaluating the Quality of the Coatings. Intermittent Immersion Tests in 5 Per Cent and 20 Per Cent Salt Solutions Were Unsuitable

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SOLUTIONS of phosphoric acid and acid metal phosphates are extensively used to produce on iron and steel articles a coating which, at least to some extent, will protect these from rusting, especially under mild corrosion conditions, as indoors. The coated articles are ordinarily oiled, and, more rarely, japanned or lacquered to increase the protective value of the coating.

This method of treatment was originated by Thomas Coslett, who obtained his first patent in 1906. Aside from patents there appears in the technical literature little information upon this process or the modifications of the process which have been used, and upon the protective value of the coatings so produced. For convenience all of these processes which involve the use of a solution of acid iron phosphate will be designated as coslettizing solutions, and the operation of using them as coslettizing.

Iron phosphate coatings are light gray in color, and unless they are to be used as a base for japanning or lacquering, are usually dyed black with either a water- or oil-soluble black dye. The oiled coatings are often used optionally to zinc or cadmium plating, on nuts, bolts, lockwashers, and similar articles. These coatings may also be used in place of black nickel and "oxidized" copper electroplated coatings, but probably find their most extensive use as a base for japan or lacquer on iron or steel.

This investigation had a twofold object, first a comparison of the results obtained from various accelerated corrosion tests, and second, the effect of variation of the bath composition upon the quality of coating so produced. The coslettizing solutions were prepared by adding definite quantities of a dry crystallized salt (approximately $FeHPO_4.H_2O$) to a solution containing a definite quantity of H_3PO_4, and adding water to bring the solution to a definite volume. For the large number of experiments run, this was deemed more desirable than analyzing each solution after its preparation.

Preparation of Crystalline $FeHPO_4.H_2O$

The preparation of the acid iron phosphate as a crystalline material free from excess of iron or other insoluble material is not as simple as one might expect, and the method used is therefore described. Three hundred cc. of 65 per cent H_3PO_4 were treated at 98° C. with 100 g. of iron, obtained by reducing iron oxide with hydrogen. A reflux condenser was used to prevent evaporation of water, and the solution was continually agitated by means of a small motor driven stirrer.

This quantity of iron will completely react and give a clear solution. About 2 g. more of iron was then added in small quantities, no further additions being made after iron phosphate started to precipitate. If too large an excess of iron is added, not all of it will be completely dissolved, and the iron phosphate product will be contaminated with particles of iron. The solution was allowed to cool and the precipitated phosphate filtered off.

The phosphate so prepared is crystalline, and may be washed free from phosphoric acid by small amounts of wash water. Further quantities of phosphate may be recovered by concentration of the remaining solution, and by further addition of small amounts of iron. This apparently cannot be continued indefinitely, because, after the process is repeated a few times, further concentration yields a gelatinous deposit of acid iron phosphate. This cannot be conveniently washed free of phosphoric acid, nor is it easily dried.

Analysis of the crystalline salt showed that the ratio of iron to phosphate radical is 1 to 1, and that the crystals also contain one molecule of water to each phosphate group. It was not possible to check quantitatively by titration the presence of one atom of hydrogen. It was

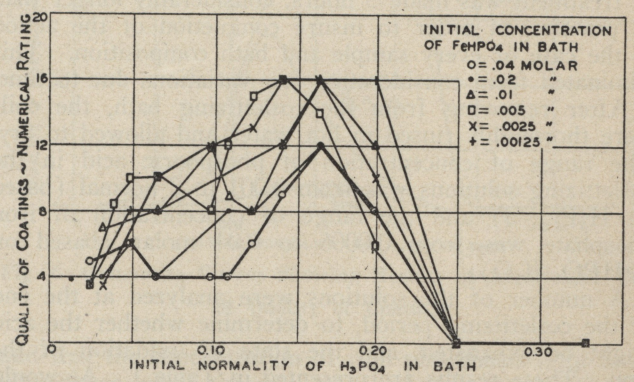


Fig. 1—Effect of Composition of Coslettizing Solution on Quality of Coatings According to Data from Salt Spray Tests

further indicated that this was not a definite salt, but more likely a mixture of acid iron phosphates, as only 82 per cent of the iron present was in the ferrous state.

Considering that both normal ferrous and ferric phosphates are known to exist in the crystalline state, it even seems possible that the molecular mixture $3Fe_3(PO_4)_2.2FePO_4.3H_3PO_4\ 11H_2O$ was obtained as a definite crystalline compound. This would closely satisfy the analytical relationships. The assembled formula would be $Fe_{11}H_9(PO_4)_{11}.11H_2O$, or, to show the iron in different states, $(Fe^2, Fe^3)_{11}\ H_9(PO_4)_{11}.11H_2O$ (mol. wt. = 1867). The approximate simplified formula $FeHPO_4.H_2O$, for acid ferrous phosphate, represents the relationships closely enough for the purposes of this paper, however, and will therefore be adopted for the present.

Coslettizing of Test Specimens

In order to compare the different methods of testing the protective value of the coatings, it was necessary to

have samples which would be as nearly as possible identical. Most of the articles which are ordinarily rust proofed by coslettizing are made of mild or low carbon steel, and therefore a dead soft steel wire (No. 20 B. and S. gauge; 0.81 mm. diameter) was chosen as the material upon which the coatings were to be produced. This wire was free from scale and had a bright smooth surface. A sample of wire 85 cm. long and weighing approximately 3.5 g. was coslettized by making it into an open coil 1.3

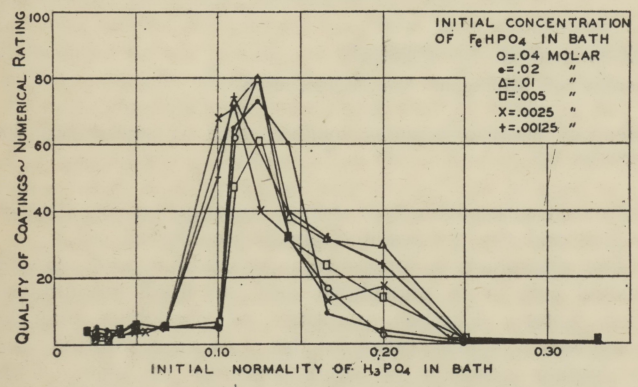


Fig. 2—Effect of Composition of Coslettizing Solution on Quality of Coatings According to Data from Distilled Water Immersion Tests

cm. in diameter and placing it in 65 cc. of coslettizing solution held in a large test tube.

A number of these test tubes were set in a bath of boiling water so that the temperature might be maintained at approximately 100° C. Each test tube was connected to a separate reflux condenser to avoid loss of water by evaporation during the coslettizing process. The time of treatment was made 5 hours, considerably longer than in practice, in order to insure completion of the action in the case of every sample and bath composition. This eliminated from consideration any variations due to time.

After removing from the coslettizing bath, the coils were thoroughly rinsed in hot water and allowed to dry. The range of concentration of phosphoric acid in the coslettizing solutions was from 0.001 to 2 normal (based on $H_3PO_4/3$) and the range of concentration of iron phosphate was from 0.0006 to 0.04 molar (based on $FeHPO_4.H_2O$).

A number of the solutions were analyzed at the end of the coslettizing period, to determine whether the acid might be exhausted, and the state of oxidation of the iron. These results are presented in Table I. As would

TABLE I—COMPOSITION OF COSLETTIZING SOLUTIONS

Original Bath			Bath at Completion of Run		
Molarity of $FeHPO_4H_2O$	Normality of "Free" H_3PO_4	Per cent of Iron in ferrous state	Per cent of Iron in ferrous state	Normality of "Free" Acid	Per cent of Original Acid Left
0.00125	0.20	82	94.0	0.132	66
0.00250	0.20	82	99.5	0.132	66
0.00125	0.166	82	98.1	0.101	61
0.00250	0.166	82	91.9	0.107	65
0.00125	0.166	56*	99.0	....	..
0.00125	0.143	..	....	0.098	68
0.00250	0.143	..	....	0.093	65
0.00125	0.125	..	....	0.078	63
0.00250	0.125	..	....	0.080	64

be expected, since hydrogen is evolved during the operation, substantially all of the iron is reduced to the ferrous state by the end of the run.

It is a question if the small amount of ferric iron found may not have arisen from unavoidable oxidation occurring during the taking of the sample and its analysis. It is interesting to note from Table I that approximately one-third of the free phosphoric acid was consumed in each run, over this range of initial acid concentration. No explanation for this result is at hand.

Accelerated Corrosion Tests

The accelerated corrosion tests which were used were the standard salt spray test[1] (20 per cent sodium chloride solution) and a number of intermittent immersion tests. In these tests the sample of coslettized wire, suspended from a glass hook, was dipped in the solution in which it was to be tested for a period of 30 seconds, and was then raised from the solution and held in the air for 11 minutes. The solutions which were used for the intermittent immersion tests were distilled water, 5 per cent salt (sodium chloride) solution, 20 per cent salt solution, and 0.01 normal sulfuric acid. In order to have samples as nearly identical as possible for these five tests, each coslettized coil of wire was cut into five pieces and one of these pieces used for each test.

In order to rate and compare the results of the corrosion tests, a modification of the method of grading described by Baker[3] was used. This method of rating involves recognition of a number of stages of rusting. These are as follows:

P	Perfect.
VSR	Very slightly rusted
SR	Slightly rusted.
NR	Noticeably rusted.
VNR	Very noticeably rusted.

The appearance corresponding to the above description is best described by reference to the extreme conditions. Perfect indicates that no rust is visible on the closest examination, and VNR designates a stage of rust which is plainly visible when the piece is held at arm's length from the eye. Between these two extremes, the three intermediate degrees of rusting designated VSR, SR, and NR were recognized. This distinction may appear to be unwarranted as the rating is, after all, a question of personal judgment. We found it easier, however, to

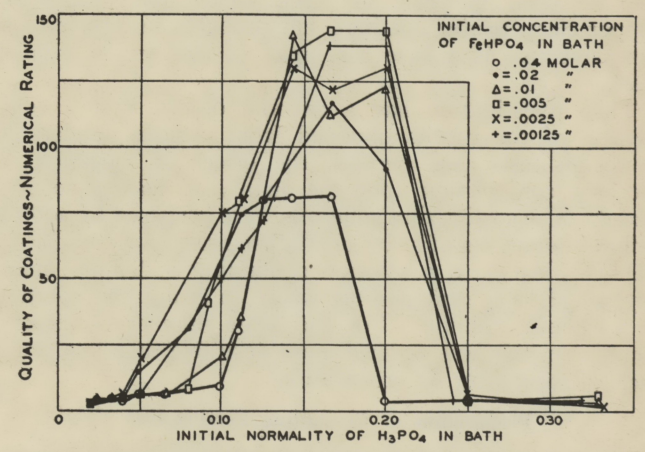


Fig. 3—Effect of Composition of Coslettizing Solution on Quality of Coatings According to Data from $\frac{N\ H_2SO_4}{100}$ Immersion Tests

grade pieces according to this rating than to distinguish between such gradings as "rusted" or "not rusted."

The pieces were examined throughout the duration of the corrosion tests at the end of each four hours. If a piece was then perfect, it was rated 4; if very slightly rusted, 3; if slightly rusted, 2; if noticeably rusted, 1; and if very noticeably rusted, 0. The sum of the ratings made at the end of each four hour period up to such time

[1] Bureau of Standards Cir. No. 80, 1922, or Rawdon, "Protective Metallic Coatings," Chemical Catalog Company 1928.

[2] J. Soc. Automotive Aug., 14, 127 (1924).

as the piece was very noticeably rusted was taken as the total rating. The rating number may therefore be considered to be the number of equivalent perfect hours.

Results of Accelerated Corrosion Tests

The results of these ratings were then plotted, and the curves are shown in Fig. 1, 2, 3, 4, and 5. In each

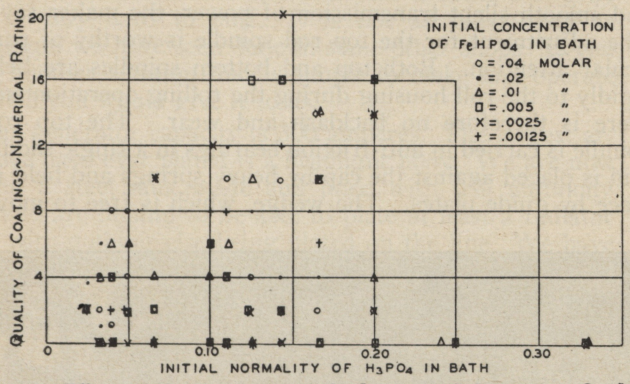

INITIAL CONCENTRATION OF FeHPO4 IN BATH
o = .04 MOLAR
• = .02 "
Δ = .01 "
□ = .005 "
X = .0025 "
+ = .00125 "
QUALITY OF COATINGS~NUMERICAL RATING
INITIAL NORMALITY OF H3PO4 IN BATH

Fig. 4—Effect of Composition of Coslettizing Solution on Quality of Coatings According to Data from 5% Salt Immersion Tests

of these figures, the numerical ratings are plotted as ordinates against the normality of free phosphoric acid in the coslettizing solutions as abscissas. The concentration of iron phosphate in each of the coslettizing solutions is also indicated on the graphs by distinctive symbols for each point plotted.

In Fig. 1, 2 and 3, representing respectively the results of the salt spray test, immersion test in water and in 0.01 normal sulfuric acid, it was possible to draw curves, or rather, broken lines for the relationship of numerical rating to concentration of phosphoric acid for each concentration of iron phosphate. In Fig. 4 and 5, which represent the results of the immersion tests in 5 per cent and 20 per cent sodium chloride solutions, the results were so erratic that it did not seem feasible to draw such curves.

From the distribution of the various points plotted in Fig. 4 and 5, it will also be observed that there was no correlation between the results of these salt solution immersion tests and the concentration of phosphoric acid in the coslettizing baths in which the specimens were treated. The immersion tests in salt solutions, therefore,

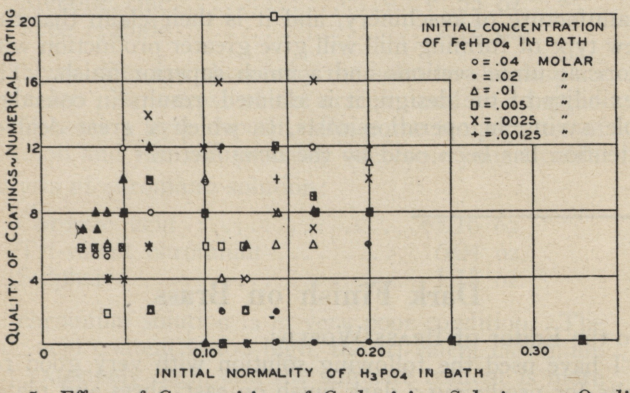

INITIAL CONCENTRATION OF FeHPO4 IN BATH
o = .04 MOLAR
• = .02 "
Δ = .01 "
□ = .005 "
X = .0025 "
+ = .00125 "
QUALITY OF COATINGS~NUMERICAL RATING
INITIAL NORMALITY OF H3PO4 IN BATH

Fig. 5—Effect of Composition of Coslettizing Solution on Quality of Coatings According to Data from 20% Salt Immersion Tests

appear to be absolutely worthless as a method of evaluating the quality of coatings produced in a coslettizing solution.

Referring again to Fig. 1, 2 and 3, it will be noted that the family of curves in each graph may be moderately well represented by a single curve. The composite curves representing those three graphs are reproduced in Fig. 6.

The best coatings were produced in a solution about 0.13 *N* in phosphoric acid according to the intermittent immersion test in 0.01 *N* sulfuric acid; at approximately 0.16 *N* phosphoric acid according to the salt spray test; and 0.18 *N* phosphoric acid according to the distilled water immersion test. The agreement in these tests is not perfect, but is sufficient to indicate that any one of these tests would give a reasonably good indication of the true quality of the coating.

The immersion tests in distilled water and in 0.01 *N* sulfuric acid are the more sensitive, but have the disadvantage of requiring a long time. The salt spray test is far more rapid, and seems to be sufficiently reliable. Its use is, therefore, recommended for the testing of coatings of this type.

Further reference to Fig. 1, 2 and 3 reveals that, in general the poorest coatings were produced from solutions most concentrated in iron phosphate, and the best results from solutions 0.005 to 0.00125 molar. The data on this point are not as consistent as might be desired, and these limits are, therefore, mere approximations. It will be noted that the baths are far more sensitive to concentration of acid than to concentration of iron phosphate.

Conclusions on Bath Composition

It appears that a coslettizing solution should be approximately 0.16 normal in phosphoric acid for best results,

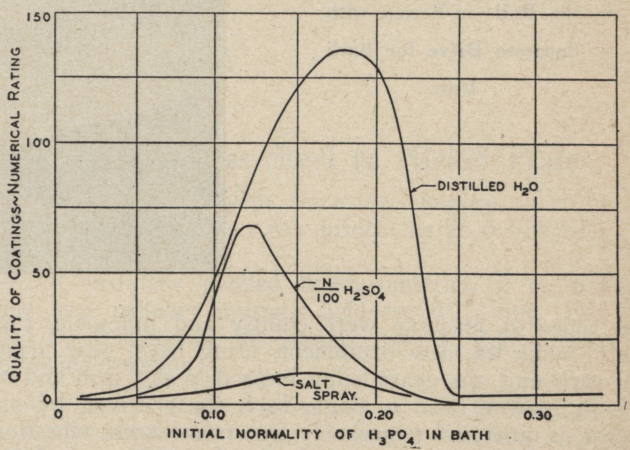


Fig. 6—Composite Curves Showing Results of Accelerated Tests of Quality of Coatings

and that the concentration of iron phosphates is of lesser importance, when the steel may be left in the solution for a long period, such as five hours.

Of course, it does not follow that the same conditions are best for shorter periods, such as 30 minutes to 2 hours. Separate observations on coslettizing solutions operated on a reasonably large commercial scale, however, do indicate that these are good conditions, and that the bath performs well over a wide range of solution composition.

Weiller Bronze

Q.—We would like you to furnish us with specifications covering Weiller Bronze, class "A," used in electrical work, and having a high conductivity and tensile strength.

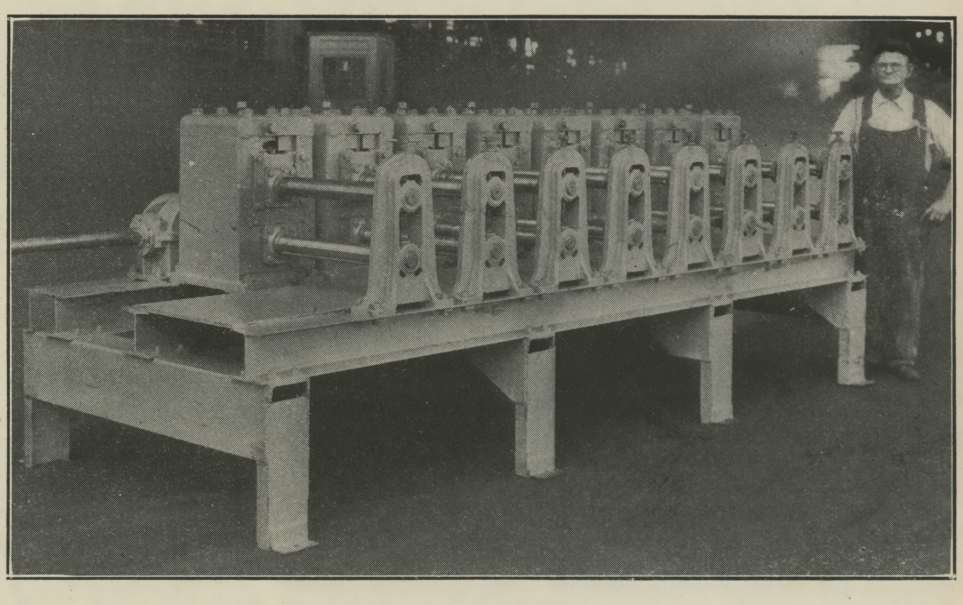
A.—We regret very much that we have no record of Weiller Bronze. If you send us a small sample of the metal we may be able to give you the desired information. If not, tell us where this alloy is used on electrical work. Is it for welding machines or collector rings? Also state the Brinnel hardness of the alloy.

—W. J. Reardon.

New Metal Former Resembles Continuous Rolling Mill

A new type of metal forming mill resembling closely the continuous type of hot bar and strip steel rolling mill that has been so successful in the steel industry, has been placed on the market by the Farrel-Birmingham Company, Buffalo, N. Y. The machine is said to be altogether different from forming mills used during the past 20 years. It is suitable for forming brass and other non-ferrous metals and alloys, as well as steel. The machine, as shown in the illustration, is built in sections, or stands, each being an individual unit with its own drive. The makers point out that former practice was to drive a series of roll with a train of spur gears, which caused a great deal of noise, vibration and surge or tramp. The old types of machine were clumsy and inflexible, they state, while the new equipment, using bevel gear drives for each unit, the gears being incased in cast iron and receiving power from a single back shaft driven by one motor, is quiet and remarkably free from excess vibration. Each stand houses the spindle bearings, the connecting gears and the mechanism for adjusting the roll centers. It has greater strength and heavier weight than the previous designs. It provides a solid and stable installation which improves the quality and finish of the product. With the individual stand it is possible to add or subtract from the mill from time to time as different shapes of metal are formed. On heavy production work, a duplicate set of stands can be made ready so that at the finish of one production job the changeover can be immediately effected.

The stand and the gear drive unit are fitted throughout with anti-friction bearings and are lubricated automatically. This is done to insure high efficiency, reliability and smooth silent transmission of power, the maker says. The adjustment for the top rod spindle is worthy of particular attention. Both top and bottom spindles are held rigidly to the roll housing during the rolling operation and there is therefore no backlash and wear. The top roll spindle is carried in anti-friction bearings in a single saddle and is placed against the cap by heavy springs and held in place by guide plates. The wedge, which is free to move in and out, is inserted between the top roll spindle and the housing cap.



A View of the Newly Designed Continuous Metal Forming Mill, Showing the Rolls in Series, with Separate Drive for Each Unit.

All materials entering into the construction of this metal forming mill have been selected with great care, the manufacturer claims. The steels are heat-treated and of alloy analysis.

Semi-steel is used instead of cast iron. The Farrel-Birmingham Company specializes in the design and manufacture of machinery, and it is their claim that this new type of forming mill will give greater production with more accurate sections and a much superior finish. The flexibility of the design, it is claimed, results in considerable saving in operation costs, to which a great deal of attention has been paid by the manufacturer.

Pitting Nickel

Q.—We are having trouble with our nickel solution pitting and are at a loss to know the cause, inasmuch as tests show the pH to be 6.2 and the metallic content to be 3½ ounces to the gallon. Any advice you can give us will be greatly appreciated.

A.—There are several reasons for the pitting of nickel plating solutions and the best remedy is to add hydrogen peroxide to the bath until the solution stops pitting. We suggest that you add 1 oz. to every 10 gallons of solution and note results. If further additions are necessary, make some, as an excess causes no harm.

—Oliver J. Sizelove.

Dark Finish on Brass

To the Editor of Brass World:

I have used the following solution with very good results for producing a dark finish on cast, sheet and plated brass:

Water	5 gallons
Hyposulphite of soda	5 to 6 lbs.
Sugar of lead	1½ to 2 lbs.

The solution is used hot. For a darker color, a larger proportion of the soda can be used.

Chicago, Ill., Andrew V. Re.
November 16, 1929.

Chromium Plating Data

Q.—We are sending you a 2 oz. sample of chromium solution composed of 55 oz. chromic acid, 3 c. c. sulphuric acid, 66%, 1 gal. water.

The trouble we are having with this solution is that it does not cover the article all over and it turns dull gray and is very hard to buff. It is not as satisfactory as chromium we have seen done in some other shops. If you have another solution that is simple to make and operate we wish you would give it to us.

Our generator capacity is 300 amperes. The largest article we have ever plated is a headlight body. We are now having a steel tank made and lined with 6% antimony lead and are hoping to be able to plate at least a radiator shell with nothing else being plated on the line. We have our chrome tank situated within 4 feet of the generator and we use a 5/8 inch bus bar.

We do not have the facilities for heating our chromium solution with steam and would like to know if it would be all right to have several gas burners under the chromium tank. We are afraid that it might injure the lead lining and also the heavy ingredients of the solution, which may be on the bottom.

We would also like to have a formula for an electric strip for nickel and chromium. What proportions of acid and glycerine are used? This solution, we understand is used in various shops.

We do not know what is meant by the "freezing method" in regard to the carbonate content in a silver solution. Will you kindly explain this?

A.—Sample of chromium solution arrived in poor condition, due to improper corkage of the bottle. A glass or rubber cork must be used in the bottle to prevent attack of chromic acid.

You will be unable to plate a radiator shell with a 300 ampere generator.

If you have no steam coil to heat the chromium solution, it is best to place chromium solution tank into a larger iron tank filled with water and heat the outer water tank with gas. Chromium is readily soluble in a hot muriatic acid dip.

A good nickel strip is made by diluting sulphuric with water to 45° Bé and then adding 1 oz. of glycerine to each gallon of solution. Use lead cathodes.

To freeze the carbonates from a cyanide solution, place the solution in a place where the temperature is just below the freezing point, 28° F. being a good temperature, when the carbonates will crystallize out and may be removed from the solution.

—Oliver J. Sizelove.

Chromium and Brass Solutions

Q.—Am sending samples of my chromium and brass solutions. The chromium does not seem to have the throwing power it used to have. Perhaps the acid content is not right.

The brass solution was working fine for a while after I made it but now it produces a plate moss grey in color, which buffs up fairly good but will not do for a background.

Please suggest the remedies for these solutions.

A.—Analysis of brass solution:

Metallic copper	2.51 oz.
Metallic zinc	.53 oz.
Free cyanide	2.12 oz.

The analysis does not show why the solution should plate a gray color. An excess of the arsenic used as a brightener will cause a gray deposit. Raise the temperature of the solution and you will probably overcome your trouble.

Analysis of chromium solution:

Chromic acid	65.16 oz.
Tri-valent chromium	6.04 oz.
Sulphates	1.13 oz.

The chromium solution is in very poor condition. The chromic acid content is too high, the tri-valent chromium content extremely high, and the sulphate content is more than twice what it should be. The solution is in such a poor condition generally that probably it would be just as cheap to discard it and make a new one.

If you wish to correct the solution, it will be necessary to reduce its volume ½ and replenish with water, then reduce the tri-valent content by the porous cup method, after which replenish the metal content by adding chromic acid.

—Oliver J. Sizelove.

Soldering Stainless Steel to Nickel Plate

Q.—We have a problem soldering stainless steel to nickel plated articles. Can you inform us as to the best acid for this purpose?

A.—For ordinary pickled finish material, i. e., not polished, use ordinary muriatic acid cut with zinc. For polished finish material, the surface may be dulled with the following solution:

Muriatic acid	90 parts
Ferric chloride	50 parts
Nitric acid	3 parts

This solution should be allowed to act for 5 to 10 minutes and wiped off. Tinning is then done in the usual way. After soldering, all traces of acid must be thoroughly removed by washing. Due to low thermal conductivity, a large soldering iron should be used.

The above is based on the use of material of approximately the following analysis: carbon, 0.15 max.; chromium, 16.5/19.5; nickel, 7/10.

—Joseph Haas.

Statuary Bronze Finish—Correction

To the Editor of Brass World:

Either I have made a mistake or you have. In my letter printed on page 186 of your August, 1929, issue, under title of "Statuary Bronze Finish," the paragraph starting, "A good white deposit can be produced by addition of 1 to 2 ozs. cyanide of mercury," etc., should read, "1 to 2 grains cyanide of mercury."

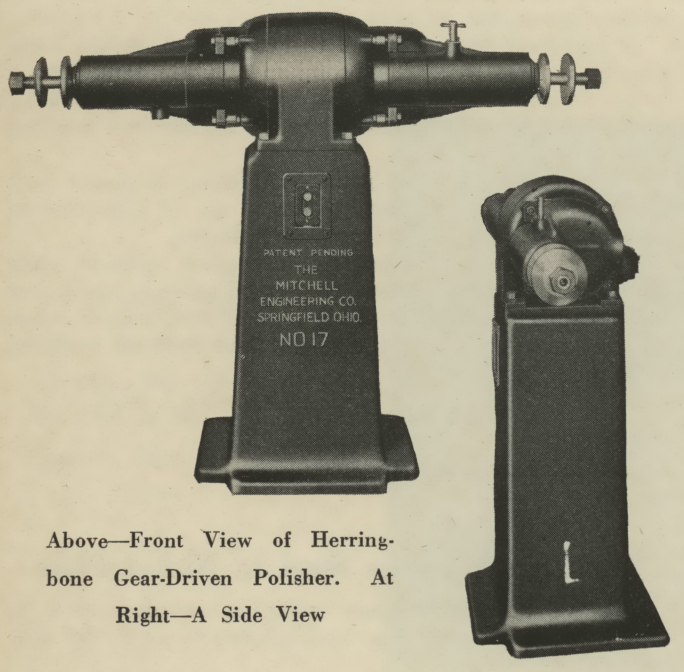
Furthermore, I have received a letter from the Roessler and Hasslacher Chemical Company, New York, telling me there is a patent on the cadmium solution mentioned in that letter.

Chicago, Ill., Andrew V. Re.
November 16, 1929.

Herringbone Gear Drive Polishing Lathe

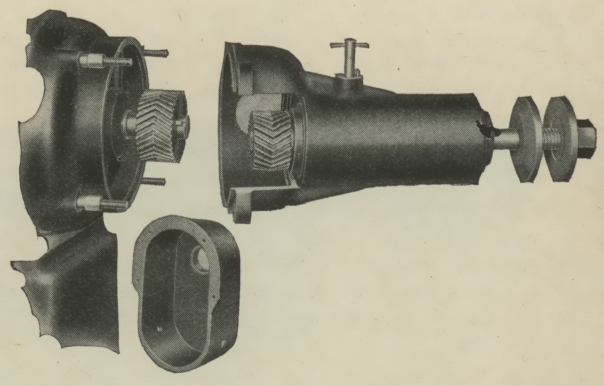
Frederic B. Stevens, Inc., Detroit, Mich., are exclusive distributors of a new type of polishing lathe developed by The Mitchell Engineering Company, Springfield, Ohio.

The apparatus is known as "The Mitchell Selective Speed Motor-Driven Polisher with Herringbone Gear Drive." The distributor's description of the machine states that the following mechanical and operating advantages are to be found in the machine:



Above—Front View of Herringbone Gear-Driven Polisher. At Right—A Side View

Continuous tooth herringbone gears with teeth cut at 40 degree helical angles, insuring quiet operation and greatest possible tooth contact; the gears have 2 in. face width and are capable of transmitting 25 horsepower; they are said to deliver 98% of total power of motor to polishing wheels; wear reduced to minimum by extreme precision in manufacture of gears and mounting; each spindle bearing housings with spindle and bearings is a separate unit, removable without distributing motor or motor bearings; motor shaft carried in two independent ball bearings, taking strain and vibration from motor bearings and preventing injury to motor should spindle bearing wear out; driving gears keyed to motor shaft with feather key, permitting rotor to float to magnetic center; gears completely encased and run in oil; spindles can be operated at different speeds independently of each other; spindles well to front of machine, putting cutting edge of machine well out in front of machine; obtainable spindle speeds are 1800, 1930, 2027, 2230, 2400, 2580, 2780, or 3000 r.p.m.



View of Gear Drive and Spindle Assembly of the New Type Polishing Machine

It is pointed out that power engineers recognize that the herringbone gear drive is the most efficient and noiseless power transmission mechanism, and that its embodiment in the Mitchell polishing lathe is a distinct advance in polishing practice.

Etching Steel and Brass

Q.—Could you give us information on how to etch steam gauge dials, with silver and black lettering, the chemicals to use, and resist ink? Have you any information on how to etch steel, such as used for measuring instruments, scales, etc.

We are also interested in information about methods for etching both Britannia metal and brass.

A.—The procedure for etching brass plates is as follows: First photograph and transfer to zinc plates by the photo-etching process. Brass plates are printed, leaving parts for etching base; powdered asphaltum is dusted on the damp ink and baked dry. The loose powder is brushed off, using talcum powder on brushes so as not to draw the letters or design. The plates are placed back to back in hard rubber frames and placed in the etching solution, No. 1, which consists of 30 lbs. muriatic acid, 6 lbs. chlorate of soda, 100 gallons water.

After the plates have been in the etching acid for 15 minutes they are examined; if cut deep enough they are removed, rinsed and placed in solution No. 2, consisting of bichromate of soda 40 lbs., sulphuric acid 3 gals., water 100 gallons. This will give the plates a nice bright finish. They are blackened in an ammonia black, consisting of water, 2 gallons; ammonia, 1 quart; carbonate of copper, 1 lb. To intensify the black from the above solution, dip plates in a solution of water, 50 gals.; bichromate of soda, 40 lbs.; ammonia, 3 gallons.

When a crystalline silver background or design is desired, the plates are first placed in solution No. 2 which gives a crystalline structure, and then lightly silver plated. The printing of the plates follows and then the procedure is regular.

The subject of etching metals is vast, and we could not cover it sufficiently to convey all the information you require. In addition to the information we are giving you, we would refer you to an article published on page 407 of BRASS WORLD, December, 1924, by George A. Banner.

—JOSEPH HAAS.

Silver, Copper, Brass, Nickel

Q.—Kindly let me know the formula for the following solutions: silver, copper, brass and nickel. I would like solutions made up so that I will be able to use them on all kinds of metals.

A.—The following formula will probably be satisfactory for job plating work:

Nickel Solution

Double nickel salts	8 oz.
Single nickel salts	4 oz.
Boric acid	2 oz.
Sodium chloride	2 oz.
Water	1 gal.

Operate nickel solution with 2 or 3 volts and a cathode current density of 6 to 8 amperes per sq. ft.

Silver Solution

Silver cyanide	3½ oz.
Sodium cyanide	4½ oz.
Ammonia chloride	½ oz.
Water	1 gal.

Operate solution at ¾ to 1 volt with a cathode current density of 4 to 5 amperes per sq. ft.

Brass Solution

Copper cyanide	4 oz.
Zinc cyanide	1 oz.
Sodium cyanide	6 oz.
Sodium carbonate	2 oz.
Water	1 gal.

Temperature, 90° F., cathode current density, 2½ to 3 amperes per square foot.

Copper Solution

Copper cyanide	4 oz.
Sodium cyanide	4½ oz.
Sodium carbonate	2 oz.
Hyposulphite soda	1/32 oz.
Water	1 gal.

Temperature 100° F.; 2½ to 3 volts cathode current density; 6 to 8 amperes per square foot.

—Oliver J. Sizelove.

Silver Solder

Handy and Harman, 57 William Street, New York City, manufacturers of precious metals, solders and other products, report the following:

In Wisconsin an ingenious man invented a new type of electric water heater and organized a corporation for its manufacture.

The laboratory sample heater worked perfectly and a factory was leased, machines were installed and materials purchased for the production of a large number of the heaters. The first hundred or so were sold and installed. Then leakage troubles broke out all along the line and the heaters came back.

The device contained a cement core heating unit enclosed in a brass cylinder. The rapid and unequal expansion due to the fact that one side of this cylinder was still cold after the other side was heated by the energized central core, caused the cylinder to part at its head, and also certain connections to give way. They called in expert welders. They tried threading the heads. Nothing succeeded until they hit upon brazing the joints with silver solder. This material solved the problem because the ductility of the silver in the solder took care of the expansion stresses, which had been so great as to rupture both threaded and autogenous-welded joints. Thus, a few cents' worth of silver solder on each $150 machine solved a problem which might otherwise have wrecked an ambitious manufacturer of a worthy device.

Handy and Harman issue an interesting booklet called "The Handy Book of Silver Solder," which can be had gratis upon request to the company.

Lacquers for Weather Resistance

The Zeller Lacquer Manufacturing, Inc., 20 East 49th Street, New York City, reports the development, after several years of research, of a new type of material to be known as "Zellac Outdoor Exposure Grades." These are a series of new lacquers especially developed for weather resistance and said to be impervious to all weather conditions. Extended tests, according to the makers, have failed to show the new grades weak in any respect, the tests including the most uncompromising practical applications. The new lacquers have now being placed in regular production.

The Zeller company points out that manufacturers have sought for years to find lacquers to apply for outdoor use. Objects of polished brass, where it is desirable to retain a high polish without frequent cleaning, present an illustration of the many articles to which such weather exposure finishing materials will come as a boon. Other metal products, and many wood products as well, the Zeller officials point out, will be definitely improved by the application of this clear nitrocellulose finish which will withstand the effects of sun, rain, wind, brine, sea-fog, snow or ice for an indefinite length of time.

Hugo Zeller, president of the company, points out that the Zeller laboratories years ago produced exposure grades, such as the well-known pigmented "Auto Zellac Top Coat Enamels," the success of which has been noteworthy to a remarkable degree. "Even our own weather grades, however," said Mr. Zeller, "have been overshadowed in point of ruggedness by the new 'Outdoor Exposure' grades. We shall go on producing all the grades we have supplied in its past, for each continues to meet the purpose it was designed to fulfill. But the new grades have proved themselves so entirely adequate when exposed to weather conditions of every kind, I am inclined to believe that they will make a reputation for themselves altogether unique in the annals of lacquer history."

The announcement describes the new materials as intended for either a clear high-gloss or clear satin finish when applied directly over wood or metal surfaces. They are made both for spray and dip application, and may be used also as a transparent top coat. A single coat is sufficient for the protection of polished or any other metal surfaces, it is claimed. For natural wood finishing, the "Outdoor Exposure" grades may be used according to the customary procedure, following the usual steps of sanding, staining, filling, sealing and wood-lacquering, with a single coat of the new material as an outside top coat.

These new materials are to be produced in standardized form as well as in modified form where required to meet special requirements when specified.

In discussing the subject of weather exposure lacquers, Mr. Zeller pointed out that the company's laboratory has worked on the problem with a great deal of concentration for several years, developing improved types step by step. "We perfected the present grades early in 1929," he said, "and demonstrated their effectiveness to our own satisfaction, both in laboratory and practical tests. However, we have withheld them until now as it is our custom to give new materials every opportunity in practical finishing demonstrations to show up any possible defects. Having made sure of our materials, we consider it is now time enough to announce them to our customers."

Nickel Plating Practice

Q.—Will you kindly analyze the sample of our 380 gallon nickel solution, which is being sent you and which is made up as follows:

Water	1 gallon
Single Nickel Salts	32 ozs.
Nickel Chloride	2 ozs.
Ammonium Chloride	2 ozs.
Boric Acid	2 ozs.
Baumé	17
pH, originally	5.6

During the first half of 1929 we used this solution at 5.6 to 5.8 with average good results (approximately 2% of the work peeling on cool days) and through the summer we had very little bad work. We then changed the pH to 6.2 but it went higher through correction to 6.4. Worked very well without any peeling at 6.2, but started peeling on chromium at 6.4. We have since made the following changes in the solution:

Added about 4 lbs. H_2SO_4
5 lbs. nickel carbonate
5 lbs. ammonium chloride
8 lbs. boric acid

The pH now stands 6.3. We use 1.5 to 1.7 volts; 30 to 40 minutes plating time. Clean our work first in electric cleaner by direct current for a couple of seconds; after rinsing in clean water we put it in potash (3 ozs. / gal.) for 5 minutes and brush it; after rinsing again in clean water we scour the work with Vienna lime, rinse again in water, dip in cyanide solution (about 8 ozs. / gal.) and put in nickel solution without current.

We are still getting too large a percentage of bad work and will appreciate your comments.

A.—Analysis of nickel solution:

Metallic nickel	6.42 oz.
Chlorides	3.26 oz.
pH	6.4

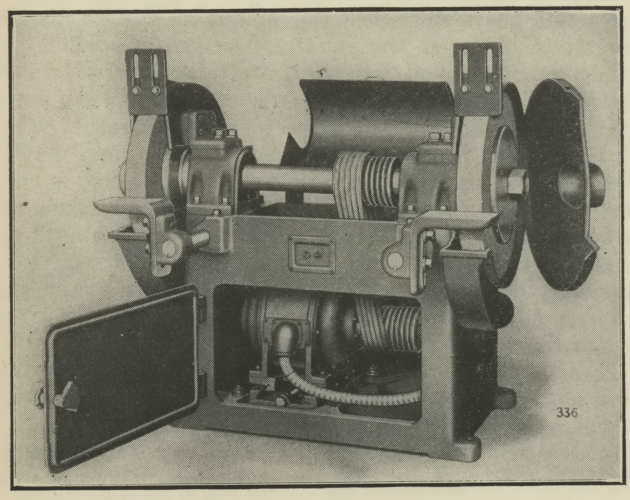
The metal content is quite high, so do not add any more nickel salts for some time to come.

The pH is too high; we would suggest that you add 15 fluid oz. C.P. sulphuric acid to the 380 gallons of solution. If you can operate the solution at 100° F., a softer deposit will be obtained and less trouble will be had with the deposit raising when chromium plated. We would also suggest that you use a muriatic acid dip, 1 part acid and 1 part water, in place of the cyanide dip before the work is placed in the nickel solution.

—Oliver J. Sizelove.

High Speed Grinder and Snagger

Consistent with the steady development of high speed production equipment for plant use, the Hisey-Wolf Machine Company, Cincinnati, Ohio, announce the development of a new type of grinder and snagger operating at speeds ranging up to 2000 r.p.m. The new series of machines are known as the "Hisey High Speed Texdrive Grinders," one of which is shown in the accompanying illustration. It is stated that the new equipment will prove another step in the speeding up of grinding operations in production plants where metals are ground.



High Speed Snagging Grinder

Especially designed for rotation of high speed grinding wheels, the makers state, these machines embody a number of desirable new features, such as convenience of operation, strength, freedom from vibration, safety, simplicity, etc. The machines are built in single and also multi-speed types. Single speed types are of three sizes, 18, 20 and 24 inch, 5, 7½ and 10 horsepower, respectively, and having respective spindle speeds of 2000, 1800 and 1550 r.p.m. According to the maker, the single speed machines are most economically used in banks of three and multiples thereof, permitting transferring of grinding wheels to smaller diameter machines as they wear down on the larger ones. The multi-speed machine has a 10 horsepower motor and takes a 24 inch wheel which operates at 9500 surface feet per minute. When the wheel is worn down to 20 inches in diameter, the machine is speeded up to keep the surface speed equal to that of the 24-inch wheel.

Silver on German Silver

Q.—Please outline the procedure for silver plating German silver articles having white metal mountings.

What will strip chromium off plated articles?

A.—The usual procedure in silver plating German silver articles that have white metal mountings is to plate for a few minutes in a warm cyanide copper solution, or else to use a special strike composed of sodium cyanide 10 ozs., silver cyanide ⅛ oz., water 1 gallon.

If the work is plated in copper solution the special strike may be eliminated, but the regular strike, composed of sodium cyanide, 6 oz.; silver cyanide, ½ oz.; water, 1 gallon, must be used before placing work in the regular silver solution. Use a mercury dip before the strike.

Chromium may readily be stripped in a muriatic acid dip. Use the acid hot and without diluting, for rapid results.

—Oliver J. Sizelove.

Nickel and Copper Solutions

Q.—We are sending samples of our nickel and copper solutions.

The nickel solution works pretty well now, but has a slight tendency to pit. We are installing a chromium tank and would like to know if this nickel solution will put on the proper plate for use under chromium.

Please test the copper solution and tell us what is wrong with it. Our plater made it up a few months ago, using copper cyanide. On bumper bars it has always blistered. This copper solution would also have to be used under the chromium.

A.—Analysis of nickel solution:

Metallic nickel	1.68 oz.
Chrorides	1.98 oz.
pH	5.6

We would recommend that you add to the 350 gallons of solution 100 lbs. of single nickel salts and 20 oz. of 26° ammonium hydroxide. Also heat the solution to 110° F., when in operation.

Analysis of copper solution:

Metallic copper	2.05 oz.
Free cyanide	.11 oz.

Add to this 90 gallon solution 6 lbs. of copper cyanide and 12 lbs. of sodium cyanide; also, 10 lbs. of carbonate soda. Operate solution at 110° F.

If your cleansing methods are correct, you should have no trouble with either deposit raising when chromium plated.

—Oliver J. Sizelove.

Chromium Solution

Q.—Please give us data on chromium plating, covering solution, temperatures, electrical requirements, etc.

Is it necessary to have a steel tank welded if it is lead lined?

A.—There has been considerable data published in Brass World and The Metal Industry from time to time which would be valuable to you. Consult past issues, if possible.

Write to Superintendent of Documents, U. S. Government Printing Office, Washington, D. C., enclosing 15 cents, for a copy of Technologic Paper No. 326, also to the Department of Engineering Research, University of Michigan, Ann Arbor, Mich., for a copy of Engineering Research Bulletin No. 10, entitled "A Study of Chromium Plating," by Richard Schneidewind. The price of this bulletin is $1.

The following formula is being used with good results:

Chromic acid	55 oz.
Sulphuric acid, C. P.	0.3 oz., by weight
Water	1 gallon

Temperature, 95° F.; cathode current density, 50 to 75 amperes per square foot.

The size of generator to operate with a 200 gallon solution will depend upon the size and volume of work to be plated. A 1,500 ampere generator should be sufficient for ordinary work.

It is not necessary to have the steel tank welded if it is lead lined, although it is preferable.

—Oliver J. Sizelove.

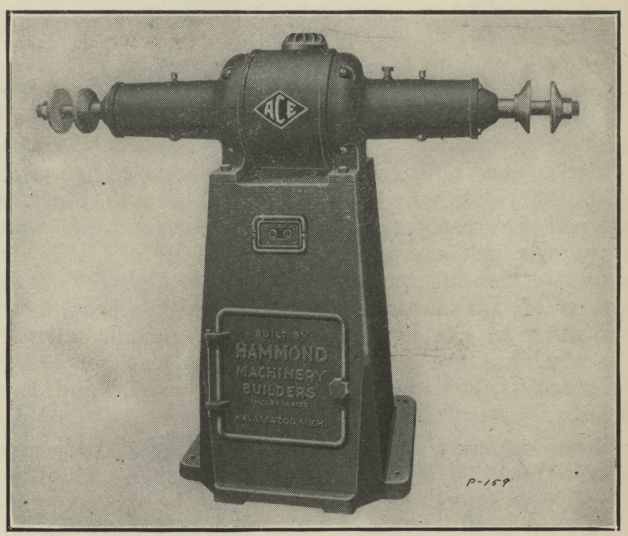
Heavy Duty Buffing and Polishing Lathes

Descriptions of a new line of heavy duty polishing and buffing lathes have been issued by the Hammond Machinery Builders, Inc., Kalamazoo, Mich. (formerly the Hill-Curtis Company). The machines are being manufactured in a complete range of sizes from three to fifteen horsepower, one type being shown in the illustration. The description, as issued by the manufacturer, is given here:

The motor, which is a 40 degree centigrade type, is especially designed for the service. It is totally inclosed, having no holes or open slots for ventilation. Clean air is supplied to the motor through "Air-Clean," without piping to outside, insuring a clean, cool efficient power unit. The motor is liberally proportioned, designed to withstand the severe load to which a machine of this kind is subject. The motor will withstand a momentary overload of 100 per cent beyond its rated capacity and without heating over 40 degrees centigrade. Push button control is conveniently mounted on the front of the pedestal with "Cutler-Hammer" automatic motor starter, having thermal overload protection, and low voltage protection conveniently mounted on the door of the pedestal.

Four oversize ball bearings support the one piece chrome-manganese steel spindle. The bearings are designed with convenient oil cup, oil level gauge and flushing plug for convenience of removing old oil and replenishing with new. Double labyrinth seals with overflow gauge prevent dirt and dust entering the bearing compartment and the oil overflow prevents surplus lubrication entering into the motor compartment. Flat top spindle thread and spindle lock are standard equipment.

The machines are regularly supplied in 220, 440 and 550 volts, 25, 50 and 60 cycle, 2 and 3 phase alternating current. Direct current machines are supplied to order.



New Heavy Duty Buffer and Polisher

These lathes are supplied in the 3, 5, 7½, 10 and 15 H. P. capacities. The two bearing machine supplied in the 1½, 2, 3, and 5 H. P. capacity.

Iron Perchloride for Etching

Q.—We are interested in securing information about commercial etching of brass with iron perchloride. We want a formula and data on the strength of such a solution. How one could freshen such a solution? What are the addition agents to do this, if there are any?

A.—Iron perchloride may be purchased ready for etching purposes by specifying its use when ordering same. It has a specific gravity of 1.38. No addition agents are required. The length of time that the work is immersed in the solution depends upon the depth of the etch required. As the solution evaporates, water may be added, but an excess of water must not be used as it will produce a rough surface and the lines of the design will not be sharp.

If the work is agitated, the solution works faster and a smoother etch is obtained.

—Oliver J. Sizelove.

Chromium on Steel

Q.—I have sent you a 4 oz. sample of a chromium solution which does not give proper results. It will not adhere to steel work, while it works fairly on copper and brass.

A.—Analysis of chromium solution:

Chromic acid	39.7 oz.
Tri-valent chromium	.43 oz.
Sulphates	.39 oz.

The analysis shows that there is nothing radically wrong with the solution. If you wish to deposit chromium upon steel for a protection against wear, we advise plating at temperature of 113° F., with a cathode current density of 125 to 150 amperes per square foot.

If the deposit does not adhere to the steel, it is undoubtedly due to your cleansing or pickling methods.

If you wish better throwing power, increase the chromic acid content to 55 ounces per gallon and use a temperature of 95° F., with a cathode current density of 75 amperes per square foot.

—Oliver J. Sizelove.

Spray Test Machines for Metals

A line of machines to apply spray tests to metals and metallic finishes has been developed and placed on the market by the Industrial Filter and Pump Company, 361 West Ontario Street, Chicago, Ill. These machines are designed for application on either salt or fresh water spray tests and are made in various sizes. They are stated to the recommendations of the United States Bureau of Standards on spray testing apparatus for application to electroplated and other metallic surfaces. The machines are stated to be useful also for testing the corrosion resisting properties of lacquer and paint surfaces, raw metals, etc.

These machines are made with ¼ horsepower compressor units. One type stated to be large enough for testing two automobile radiator shells, or the equivalent of this in smaller articles. The testing compartment is 34 in. high, 12 in. wide and 26 in. long. Another size, for small work, is 24 in. high, 12 in. wide and 26 in. long. Sizes can be manufactured to order to meet requirements. All the machines are equipped with cabinets of Allegheny metal. The machines are made so that tests can be run over night without attention.

Cyanide Copper Solution

Q.—Under separate cover we are mailing you a sample of our cyanide copper solution. The anodes become coated with a black scum and the plate becomes dark and streaked. We run the tank at about 120° F., and if the anodes are cleaned the plate seems to be all right, but after one or two hours plating the anodes will be black again and the plate will be dark.

Is there any practical way of telling by observation whether or not, there is enough free cyanide in the solution?

A.—Analysis of cyanide copper solution:

Metallic copper	5.41 oz.
Free cyanide	2.40 oz.
Carbonates	13.7 oz.

The high carbonate content is the cause of your trouble. We would suggest that you add one pound of barium chloride to each gallon of solution. Dissolve the barium chloride in the smallest amount of water possible and add it to the copper solution. Stir the solution thoroughly, let it stand over night and then siphon off the clear liquid. Clean out the tank, replace the clear solution, and replenish with water.

—Oliver J. Sizelove.

Tin Solution, Nickel Strip

Q.—I am in need of a formula for an electro-tin solution. Please also state formula for an electric nickel strip.

A.—Formula for tin solution:

Sodium stannate	12 oz.
Caustic soda	2 oz.
Sodium acetate	2 oz.
Water	1 gallon

Temperature 120° to 140° F.; 4 to 6 volts; 5 to 10 amperes per square foot of cathode surface. Use part tin and part cold rolled steel for anodes.

Nickel strip:

Sulphuric acid	3 gallon
Water	1 gallon
Glycerine	1 oz.

Use lead cathodes and highest current density possible with 6 volts.

—Oliver J. Sizelove.

Silver Deposit by Friction

Q.—I am trying to work out a formula for depositing a thin plate of silver on copper, nickel, iron, steel, etc., by friction, but without first coating the iron or steel with copper. It should not contain cyanide.

Do you know of any method of chromium plating by immersion only?

A.—A silver paste that will work well on copper or brass is made as follows:

Silver chloride	1 oz.
Cream tartar	8 oz.
Sodium chloride	8 oz.
Water	1 qt.

The three salts are thoroughly mixed or ground together and then added to the water. For a filler use floated silica. This will not produce a film of silver on iron or nickel.

We are aware of no method that can be used to plate chromium by immersion.

—Oliver J. Sizelove.

BRASS WORLD

And Plating — Polishing — Finishing

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CONTENTS

Protecting Aluminum and Its Alloys from Corrosion 287
By Our London Correspondent
Iron Plating Solution 289
By Oliver J. Sizelove
Gold Strip Analyzed 289
By Oliver J. Sizelove
Strength Tester for Cleaners 289
Reclaiming Battery Lead 289
By W. J. Reardon
Refining Solder Dross 290
By W. J. Reardon
Alloying Copper and Aluminum 290
Furnaces for Zinc Metallics 290
Sweating in Bronze Castings 290
Casting Monel Metal 291
Casting Brass Slabs 291
Brass Type 291
Cleaning Castings 291
Molding Sand 291
Testing Quality of Deposits 292
Cadmium and Copper Solutions 292
Nickel Plating Data 292
Scientific Plating Control 292
Accelerated Corrosion Tests for Coatings of the Iron Phosphate Type 293
E. M. Baker, A. J. Herzig and R. M. Parke
New Metal Former Resembles Continuous Rolling Mill 296
Pitting Nickel 296
Dark Finish on Brass 296
Chromium Plating Data 297
Chromium and Brass Solutions 297
Soldering Stainless Steel to Nickel Plate 297
Statuary Bronze Finish—Correction 297
Herringbone-Gear Drive Polishing Lathe 298
Etching Steel and Brass 298
Silver, Copper, Brass, Nickel 299
Silver Solder 299
Lacquers for Weather Resistance 299
Nickel Plating Practice 300
High Speed Grinder and Snagger 300
Nickel and Copper Solutions 301
Chromium Solution 301
Heavy Duty Buffing and Polishing Lathes 301
Iron Perchloride for Etching 302
Chromium on Steel 302
Spray Test Machines for Metals 302
Cyanide Copper Solution 302
Tin Solution; Nickel Strip 302
Silver Deposit by Friction 302
Editorials 303
Questions and Answers 304
Associations and Societies 305
Business Reports in Brief 309
Metal Prices 311
Supply Prices 312

BRASS WORLD is regularly indexed in the Industrial Arts Index.

Plating Research Must Go On

THE American Electroplaters' Society is about to complete its three-year research program, funds for which were subscribed by the Society itself and the electroplating trade. It is now proposed that the fund be renewed for another three-year period. Questions have arisen as to the best way to go ahead, whether to continue along the same lines as in the past, or work out new facilities for carrying on extended research. There is the possibility of doing work through fellowships at universities as well as through associates at the Bureau of Standards.

The time to prepare for the new program is now. Funds must be raised and plans must be set in motion so that there shall be no halt or even delay in the project. We are not overmuch interested in the question of where and how the research is to be done. This can safely be left in the hands of the Research Committee, able and industrious as it is. There is only one really important point in our mind, and that is that the research program should continue without hesitation. It is too valuable both in the present and in the future to delay, as even a short stop may endanger the whole march.

There are too many open questions in the technique of electroplating which are still crying for answers. Chromium is in its infancy; corrosion control is one of the vital needs of the day; standardization of deposits, and testing methods call for intensive and extensive work. In addition there are numerous less fundamental but very important practical problems which no individual can undertake to solve alone, but which a co-operative effort can meet successfully.

The research program of the American Electroplaters' Society must be carried on.

Alloys for Motors

THE Society of Automotive Engineers Journal reports progress in development of special alloys for motor vehicle and aircraft engines. Light alloys are being given greater regard due to their utility in reducing the weight of cars with consequent increases in speed and savings in operating costs. Especially is this true for aircraft, where lightness is super-important. Experiments have been made with a cast iron-monel metal alloy, to be used for cylinders in which aluminum pistons are to run. Aluminum, it is stated, has been found successful as bearing material for steel shafts hardened by a new nitriding process.

January Publication Date

WE must call to the attention of our readers at this time, the fact that the January issue of BRASS WORLD will be somewhat delayed in reaching their hands. This issue, our largest of the year, calls for more than usual time in preparation.

Our subscribers are accustomed to receive BRASS WORLD between the 20th and the 25th of each month. The January issue may be delayed as much as a week. We ask our readers' indulgence and hope they will be compensated by the additional material included in this issue.

Questions and Answers

All inquiries are answered in the order received and, whenever possible, the answers published in the next regular issue

Aluminum Cleaner

Q.—Please advise us as to a polish to keep aluminum clean. We are referring to big bus radiator shells that are of polished aluminum. By the time they go through the various departments and are installed on the radiators they are rather dirty and sometimes water stained.

A.—To clean the aluminum radiator shells after assembling, we would suggest that you use the following solution, applied with a soft cloth and rubbed dry with another piece of soft cloth:

Powdered borax	2 ozs.
Water	1 gallon
Ammonium hydroxide	½ pint

If you wish to hand-polish the shells after cleaning there are a number of aluminum polishing preparations on the market.

—Oliver J. Sizelove.

Bichromate Pickle for White Metal

Q.—I would greatly appreciate any information you can give me on handling a bicromate pickle. I am using this for white metal and would like to use it as an immersion rather than boiling it in a copper pickling pan, as the pans do not stand up.

A.—If you wish to use the bichromate pickle for immersion, it will be necessary to place it in a glazed crock. Place the crock in a wooden tank that can be filled with water, which in turn should have a steam coil to heat it.

This method will probably require a little more time to pickle the work as 185° F. will be about as high as you will be able to heat the pickle.

—Oliver J. Sizelove.

Bright Silver Plate

Q.—Can you send us the formula for a silver solution for bright plating a cheap class of goods? In Sheffield, Eng., they produce a plate which has a blue cast and is soft and half bright, like velvet. Do you know how this is produced?

A.—Formula for bright silver solution:

Silver cyanide	3 ozs.
Sodium cyanide	4½ ozs.
Ammonium chloride	1/16 ozs.
Water	1 gal.

For a brightener, carbon bisulphide is used. To prepare the brightener, take 1 ounce of carbon bisulphide and 1 ounce of ether; place in a quart bottle; add 8 ounces of sodium cyanide; fill the bottle by adding some regular silver solution; shake thoroughly until the carbon bisulphide is all dissolved. One ounce of this solution will be enough to add to every 15 gallons of the regular solution.

Use a slightly higher current density than with the regular silver plating bath and avoid using an excess of the brightener.

—Oliver J. Sizelove.

Chromic Acid Stains

Q.—Can you give us any information as to a method of neutralizing the yellow stain of chromic acid that is formed in crevices and depressions of work that has been chromium plated?

We plate some articles that are hollow and have only small drain holes. It is very difficult to rinse these articles sufficiently well to remove all traces of the chromic acid. If there is any way of neutralizing this stain we would be very glad to be informed of the method.

A.—To remove chromic acid stains, after thoroughly rinsing in cold and hot water, dip articles in a 1 oz. per gallon hot caustic soda solution, then rinse again thoroughly in cold and hot water.

—Joseph Haas.

Chromium Plating

Q.—Although working in Australia, I have been a reader of your journal for some years and have derived much benefit from it. Here in Australia we lack the opportunity of belonging to such a fine institution as the American Electroplaters' Society.

I am in need of information on chromium plating. We operate two 300 gallon chromium solutions, made up of British chromic acid salts the composition of which we do not know. The instructions were to use 85 oz. of these salts to each gallon of water, at temperature of 98° F. The solution is very dense and produces very erratic results. After reading some of your articles, we tried reducing the density and increasing the temperature to 130° F. This produced very fine results on such articles as radiator shells for all makes of cars, and also on bumper bars, etc. Some parts, however, fail to cover well, the throwing power being poor. How is throwing power improved? Please send me any data you care to on chromium.

A.—A chromium solution made of 85 oz. of chromic acid per gallon, would be quite high in chromium and we doubt very much if best results could be obtained from such a solution. Best results are had when the chromic acid content is between 50 and 55 oz. per gallon, and the sulphate content (as sulphuric acid) from .3 to .4 oz. per gallon.

With a solution of this type a lower current density can be used, with a corresponding decrease in temperature,

which produces better throwing power. To increase the throwing power of your solution we would suggest that you reduce the specific gravity to 1.28, which corresponds to 32° Beaumé, or 55.6 Twadell, and reduce the temperature to 95° Fahrenheit or 35° Centigrade, and use a cathode current density of 50 to 75 amperes per square foot.

It is hard to advise as to the sulphate content without an analysis, but if the work comes from the solution with a brown discoloration, add a small quantity of C.P. sulphuric acid and note if there is any improvement. Avoid an excess as this is just as harmful to throwing power as a deficiency.

—Oliver J. Sizelove.

Copper and Tin Plating

Q.—I am a plater for a large radio concern and have had considerable trouble with my copper and tin solutions. The copper solution used for mechanical plating plates very hard and rough and if peels. The revolving of the barrel scratches the copper off and the steel shows up.

The tin solution is used in plating contacts and lugs for radio sockets of brass and bronze. Tin plating makes the soldering easy. The solution plates very light on bronze and is easily rubbed off. On brass it will not deposit whatever, regardless of voltage, etc.

What do you recommend?

A.—It is difficult to give a definite answer to your question in reference to the copper solution without making an analysis of it or seeing a sample piece of work. A blistered deposit of copper is usually caused by an excess of free cyanide and too high a current density being used. A hard deposit is caused by poor conductivity and an excess of hyposulphite of soda. If you have checked the factors mentioned and results are no better, send a 2 or 3 oz. sample bottle of solution for analysis.

Use the following tin solution:

Sodium stannate	12 oz.
Sodium acetate	2 oz.
Caustic soda	1 oz.
Powdered rosin	1/32 oz.
Water	1 gallon

Temperature, 140° F., 4 to 5 volts.

—Oliver J. Sizelove.

Nickel Solution Analysis

Q.—I am sending sample of my nickel solution for analysis and your suggestions as to a means of improving it.

I have a 375 gallon tank of this and am using it a great deal. When I make additions of salts, chloride, boric acid and muriatic acid, the chloride seems to make the work dark for a few days. Sometimes it is real black.

What does boric acid do in a solution?

A.—Analysis of nickel solution:

Metallic nickel	3.61 ozs.
Chlorides	2.34 ozs.
pH	5.4

Analysis shows that three constituents of the solution are in about the correct proportions for a good operating solution, although the pH is a little low. We would not advise adding any more chloride for some time as this constituent, when added to a nickel solution, practically remains constant except for the drag out. The boric acid has the property of helping to maintain a more constant pH.

—Oliver J. Sizelove.

Sulphide on Copper

Q.—I am sending you a name plate taken from one of our caskets and you will notice that we are having trouble with the finish peeling off this plate.

This is a britannia metal plate, cleaned with prepared cleaner, plated in a cyanide copper solution, oxidized with liver of sulphur and sprayed with regular lacquer.

Any suggestions you can give us to remedy this problem will be greatly appreciated.

A.—After a careful examination of the sample, we are of the opinion that your trouble is due to the work not being clean when the sulphide is produced upon the copper.

After scratch-brushing the copper deposit and before placing the work in the sulphur solution, be sure it is perfectly clean. Powdered soap bark is a good material to use in the scratch brush water. An excess of hyposulphite of soda in the copper solution will cause the same trouble that you are having, but we believe that this particular piece of work was not thoroughly cleaned.

—Oliver J. Sizelove.

Associations and Societies

REPORTS OF THE CURRENT PROCEEDINGS OF THE VARIOUS ORGANIZATIONS

American Foundrymen's Association

HEADQUARTERS. 222 WEST ADAMS STREET. CHICAGO, ILLINOIS

Non-Ferrous Shop Operation Course

At the coming annual convention of the American Foundrymen's Association, to be held in Cleveland, May 12th to 16th, 1930, there will be a Non-Ferrous Shop Operation Course for brass foundrymen, along the lines of that given in recent years for the grey iron interests.

The subjects dealt with will include crucible open fire and electric furnace melting practice. The matter of gating will be discussed as well as the effect of pouring temperatures and pouring practice.

The course will be held at 4:00 P. M. during the days of the meeting and each subject will be in the hands of a leader who is an authority on the particular phase of brass foundry practice.

The Non-Ferrous Shop Operation Course is in charge of a committee of which W. F. Graham is chairman. He can be addressed at The Ohio Brass Company, Mansfield, Ohio.

Nominating Committee Complete

The 1930 Nominating Committee was completed recently with the election of four members by a letter ballot of the Association membership, returned November 4.

Election judges canvassed 816 votes, declaring the following elected to the committee:

M. J. Evans, vice-president, Whiting Corporation, Harvey, Ill.

R. J. Doty, plant manager, Reading Steel Casting Company, Reading, Pa.

Wm. J. Grede, president, Liberty Foundry, Inc., Milwaukee, Wis.

T. H. Addie, president, American Manganese Bronze Company, Philadelphia, Pa.

In addition to four members elected annually, the By-Laws of the Association also provide that the Nominating Committee shall include the last three living past-presidents of the A. F. A. The past-president thus automatically members of the 1930 committee are A. B. Root, Jr., Hunt-Spiller Manufacturing Corporation, Boston, senior past-president and chairman of the committee; S. W. Utley, Detroit Steel Casting Company, Detroit; and S. T. Johnston, S. Obermayer Company, Chicago.

A meeting of the 1930 Nominating Committee will be held shortly after the first of the year to consider suggestions from members of the Association as to candidates for officers and directors.

Study Liquid Shrinkage

Progress in the investigation of the problem of liquid shrinkage being carried on through the co-operation of the American Foundrymen's Association and the Bureau of Standards, is indicated in a report submitted by E. J. Ash, research associate for both organizations, to the committee on cast iron of the American Foundrymen's Association.

The first investigations were carried out on cone-shape specimens cast in dry-sand molds. The external pipe and internal voids were determined by weighing, filling the pipes with wax, and calculating the volumes. However, true shrinkage values could not be obtained due to non-uniformity of metal temperature, and because a volume change takes place in some of the metal during the casting period.

Consequently, a new procedure was developed which is termed the crucible immersion method. This consists in immersing a crucible of known volume into a ladle of molten metal and filling the cavity of the crucible, allowing sufficient time for the crucible and the metal to reach a temperature equilibrium. When this state is attained a lid is pressed down firmly on the crucible and the whole removed from the melt. After cooling, the resultant ingot is weighed, and through the known volume of the crucible, the specific volume value of the metal at the temperature of sampling may be determined. Results obtained with 98.5 per cent aluminum show a solidification shrinkage, based on liquid volume at 656 degrees Cent. of 6.4 per cent. This method only can be used to collect data for constructing the specific volume curve of the liquid metal. Also it will be possible to express the relative tendency of metals to distribute their solidification shrinkage between external pipe and internal voids. This distribution may be largely a function of the quantity of the heat contained in the lid which acts as a hot top. Similar data will be obtained for zinc, No. 12 aluminum alloy, lead and probably the 85-5-5-5 brass. Following these the work will continue in collecting data on cast iron.

American Electroplaters' Society

HEADQUARTERS, CARE OF GEORGE GEHLING, 5001 EDMUND STREET, PHILADELPHIA, PA.

Boston Branch

HEADQUARTERS, CARE OF A. W. GARRETT, 45 KING STREET, DORCHESTER, MASS.

December Meeting

The regular monthly meeting of the Boston Branch of the American Electroplaters' Society was held at the American House, Boston, on Thursday, December 5th, at 8:00 p. m. The meeting was called to order by President L. A. Gale. All officers were present. Communications and bills were read and approved. Under the head of new business the governing committee brought in a report approving Mr. Wood's offer to have all interested members attend a weekly educational meeting at his laboratory. President Gale instructed the secretary to write all members informing them of the opportunity.

Mr. Wood, as librarian, took charge of the educational part of the meeting. He read a technical discussion on hydrogen ion control and afterwards demonstrated the pH comparator, using two solutions with a distinct difference in the acidity. The colorimetric method of nickel determination, and an entirely new compact outfit for chemical determination of the chlorides in a nickel solution, accurate to one-third of an ounce per gallon and requiring no more than two or three minutes for the test, were also demonstrated.

From this point on a very general discussion was entered into by all present. Several new and interesting problems were brought up and everyone became so engrossed that the meeting had to be forcibly adjourned at 10:45 p. m.

—Thomas Johnson, Secretary.

Baltimore-Washington Branch

HEADQUARTERS, CARE OF G. F. P. TURNER, 5324 MAPLE AVENUE, PIMLICO, BALTIMORE, MARYLAND

Annual Meeting and Banquet

The Baltimore-Washington Branch of the American Electroplaters' Society will hold its annual educational session and banquet on January 25, 1929. The events will take place at the Hotel Raleigh, Washington, D. C. There will be an educational session starting in the early afternoon, followed by the annual banquet in the evening.

A. E. S. Convention

The members of the Baltimore-Washington Branch extend a hearty welcome to platers and their friends everywhere to attend the Annual Convention of the American Electroplaters' Society, to be held from June 30 to July 3, inclusive, 1930, at the Hotel Mayflower, Washington, D. C.

—George F. P. Turner, Secretary,

Bridgeport Branch

HEADQUARTERS, CARE OF WILLIAM EHRENCRONA, R. F. D. NO. 1, BRIDGEPORT, CONNECTICUT

"Old-Timers' Night"

The Bridgeport Branch, American Electroplaters' Society, held "Old-Timers' Night" on Friday evening, November 15, at the office of the Contract Plating Company, Bridgeport. The meeting was turned over by President Waystaff to Chairman Chamberlain of the Progress Committee. Due to the fact that the Newark Branch was holding its regular meeting the same night, Horace Smith, Supreme President, Oliver J. Sizelove and Philip Siever-

ing, members of that branch, were unable to attend as had been expected. R. J. O'Connor read a letter expressing their regret at their inability to attend.

The first speaker of the evening was Mr. Cassell, of the Udylite Company, who spoke on "Cadmium Plating." The talk was very practical and conveyed much valuable information. He explained the discovery of "Udylite," its applications, and discussed the corrosion resisting properties of cadmium.

"Polishing of Stainless Steel" was the subject of a talk by Mr. Brown of the Norton Company, Worcester, Mass. This paper also contained a great deal of useful data, covering set-up of polishing wheels and the operations necessary for complete finishing of stainless steel.

After the chief speakers were through, the chairman called upon a number of the older members of the Branch to relate some of their experiences.

Rrefreshments were served after the speaking, the party breaking up at a very late hour.

—R. J. O'Connor.

Chicago Branch

HEADQUARTERS, CARE OF J. C. KRETSCHMER, 1914 WARNER AVENUE, CHICAGO, ILLINOIS

Annual Banquet, January 13

The Chicago Branch of the American Electroplaters' Society will hold its annual banquet on Saturday evening, January 18, 1930. The affair will take place in the Red Lacquer Room of the Palmer House, Chicago. During the afternoon the annual meeting and educational session will take place.

Los Angeles Branch

HEADQUARTERS, CARE OF M. D. RYNKOFS, 1354 WEST 25TH STREET, LOS ANGELES, CALIFORNIA

Regular meeting was held on the second Wednesday in November at the Y. M. C. A. Hall, President C. E. Thornton presiding and all officers present. Thirty-seven sat down to dinner at 6:30 p. m. The business session was exceptionally long, and very little time was spent on the educational discussions.

L. Riess, of the Philadelphia Branch, Robert Gripp, our first president, and Mr. Blum of San Francisco were present, all three giving us interesting talks.

A motion that the Los Angeles Branch donate $50 this year to the Research Committee was carried.

The question box contained a number of questions which were satisfactorily answered.

Charles Russill promised to get in touch with members of the Los Angeles Board of Education to see if arrangements could be made for a chemistry class in one of the schools.

We urge all of the members and applicants to be present at the next meeting, which will be held in the Y. M. C. A. Hall, Los Angeles, on December 11, at 6:30 p. m.

—M. D. Rynkofs.

International Fellowship Club

HEADQUARTERS, CARE OF T. A. TRUMBOUR, BOX 183, WALL STREET STATION, NEW YORK CITY

Dinner at Chicago, January 18

The annual Good Fellowship Dinner of the International Fellowship Club will take place in private dining room No. 9, Palmer House Hotel, Saturday, January 18, 1930, during the annual meeting of the Chicago Branch of the American Electroplaters' Society, which takes place at the Palmer House the same date.

There will be several speakers at the dinner.

Philadelphia Branch

HEADQUARTERS, CARE OF PHILIP UHL, 2432 NORTH 29TH STREET, PHILADELPHIA

Annual Meeting and Banquet

The annual banquet and open meeting of the Philadelphia Branch of the American Electroplaters' Society was held on November 23rd at McAllister's Hall, Philadelphia.

The Educational Session was opened at 3 P. M., with Dr. Hiram Lukens of the University of Pennsylvania as chairman. A comprehensive program included papers on a variety of subjects and of the very highest grade.

After the opening speech, in which Charles H. Proctor discussed how the branches of the Society could best further its interests and their own, a paper was read by Clayton M. Hoff of the Grasselli Chemical Company, Cleveland, on Cadmium Plating. Mr. Hoff traced the history and growth of the industry pointing out that in ten years the use of cadmium for electroplating had grown to a magnitude of 100,000 pounds per month. Cadmium is used in a wide variety of work, but particularly for rust protection. Mr. Hoff described the composition of cadmium baths, the formation and removal of carbonates from the solutions, the proper shapes for anodes, methods of determining the size of the equipment, calculations of costs and commercial constituents involved.

Norman Gebert of the American Chain Company, York, Pa., described the improved corrosion tests of electro-deposited metals as carried on in his plant. All nickel plated work is subjected to the ferroxyl tests for two hours for porosity of plating of nickel on steel or brass. For a brief description of the apparatus used in this test, see *The Metal Industry* for July, 1929, page 349.

Dr. Blum of the Bureau of Standards, Washington, D. C., spoke on throwing power in chromium plating, basing his talk on the report of H. L. Farber, research associate of the American Electroplaters' Society at the Bureau, on the research work which he had been doing. Through this work a method was developed of giving numerical value to throwing power, which would check the practical results obtained. The details of this investigation will be published in the near future as a research paper of the Bureau of Standards.

Dr. Graham of the University of Pennsylvania spoke on the Control of Hydrogen Ion Concentration in Solutions for Nickel Deposition, recommending the testing and correction of nickel solutions by titration analysis rather than the colorimetric method of determining the pH, in order to eliminate the cut and dried procedure necessary to bring solutions to the proper acidity.

The last part of the meeting was devoted to the question box period, in charge of George B. Hogaboom of the Hanson Van Winkle Munning Company, Matawan, N. J. A variety of questions were asked and answered in this period by Mr. Hogaboom and various members on the floor.

The banquet was held at 7 p. m. and was a gay affair. It was followed by an unusually entertaining vaudeville show and a dance.

The outstanding social feature of the meeting was the presentation to George Gehling of a diploma giving a vote of thanks of the Philadelphia Branch to him for his earnest and capable efforts for eight years on behalf of that Branch and electing him to honorary membership therein. It was a signal honor to one of the most popular members of the Society and fully deserved in every way.

A number of attractive souvenirs were distributed and prizes given by the electroplating supply houses. It is safe to say that every one of the 400 members and guests who attended the meeting and banquet had a most enjoyable and worth-while day.

Annual Conference, Oakite Products, Inc.

The 110 district managers and representatives comprising the field organization of Oakite Products, Inc., New York City, met in the general offices in New York from November 20th to 23rd, on the occasion of their twenty-first annual sales conference.

Every section of the United States and Canada was represented by this organization, so that the daily discussions covered every kind of cleaning work. Among the papers read were those referring to Paint Removing, Cleaning in the Dairy Industries, Cleaning Steel for Porcelain Enameling, Cleaning Oil Tank Cars, Selling to Bottlers, Servicing Automobiles and Busses, Hotel Cleanliness, Cleaning Service for Railroads, as well as detailed discussions and practical working tests on laundry and textile problems. There was opportunity for exchange of ideas on all subjects relating to cleaning, which was augmented by special laboratory demonstrations made by the technical and laboratory staff, as well as by men who have made certain fields their special study.

Oakite Products, Inc., holds a similar conference every vear to acquaint each of its men with improvements in cleaning equipment and cleaning methods.

The conference was culminated by the annual dinner, at which there were about 350 officials, employees and friends of the company. This was held at the Hotel Pennsylvania, in the form of the "Oakite Overland Special," with everyone impersonating a railroad man through the aid of rough shirts and engineer's caps furnished to all guests. The dinner was enlivened by music by the Oakite Radio Orchestra, which was present at the dinner. There were after-dinner speeches by D. C. Smith, who gave reminiscences of his early days with Luther Burbank, the great plant wizard, and D. C. Ball, president of the company, who discussed various topics, including red neckties and the benefits of work to mankind. He delivered a poem on the latter subject in a very forceful and completely effective manner. A good vaudeville show completed the evening's entertainment.

It was announced at the dinner that the Rochester (Empire State) division led all of the company's sales sections in the drive for new business just completed. This division was headed by H. C. Bernard, Rochester Divisional Manager.

Zapon Company Expansion at Cleveland

The Cleveland branch of The Zapon Company, Stamford, Conn., has just completed a new modern office building on its property at 8810-12-14 Bessemer Avenue, Cleveland. The space formerly occupied by the office in the general warehouse will be converted into a laboratory for developing new lacquer enamel finishes and a spray room for the convenience of the trade. The branch is in charge of W. J. Terpenny, pioneer in the lacquer industry.

Charles F. L'Hommedieu & Sons

The Chas. F. L'Hommedieu and Sons Company of Chicago, Ill., manufacturers of plating and polishing supplies and equipment, have completed a new branch warehouse and light manufacturing plant at East Los Angeles, Cal., in order to accommodate their increased number of Pacific Coast customers. The new plant, shown in the illustration here, has grounds 150 by 200 ft., at 6060 Ferguson Drive. It is equipped with switchtrack facilities connecting with the Union Pacific Railroad. A large stock of supplies and machinery is carried at this branch.

Power and Mechanical Engineering Show

An extensive exhibition of machinery, equipment and materials, including a great many non-ferrous metal products, was held at the Grand Central Palace, New York, under the auspices of the Eighth National Exposition of Power and Mechanical Engineering during the week of December 2. While this show is largely devoted to power equipment of various types, such as stokers, boilers, steam fittings, electrical apparatus, recording instruments, etc., there were a number of exhibits of interest to the non-ferrous metal trades. Among these were the following:

American Blower Corporation, blowers, unit heaters, etc.; American Brass Company, brass and bronze products; American Gas Association, furnaces, melting pots, ovens; American Society of Heating and Ventilating Engineers; Anaconda Copper Mining Company; Armstrong Cork and Insulation Company, furnace lining materials; Bearium Bearings, Inc.; Bernitz Furnace Appliance Company; Botfield Refractories Company; Bristol Company, recorders; Brown Instrument Company, recorders; Carboloy Company, Inc., machine tools; Carborundum Company; Joseph Dixon Crucible Company; Doehler Die Casting Company; Duriron Company, Inc., acid-proof apparatus; Foxboro Company, recording apparatus; General Electric Company; Harbison-Walker Refractories Company; Hisey-Wolf Machine Company, grinders; The International Nickel Company, Inc.; Keystone Refractories Company; King Refractories Company; Leeds and Northrup Company; Oakite Products, Inc.; Pyrometer Instrument Company; Quigley Furnace Specialties Company; Refractory and Engineering Corporation; Scovill Manufacturing Company, brass and bronze products; Superior Die Casting Company; C. J. Tagliabue Manufacturing Company; Taylor Instrument Companies; Weston Electrical Instrument Company.

Waukegan Chemical Plant Enlarged

The Waukegan Chemical Company, Waukegan, Ill., manufacturers of lacquers, solvents, etc., has under way the construction of a new 4-story plant addition which will cost in the neighborhood of $85,000 and will be complete about February 1, 1930, according to Casper Apeland, president of the company. The new building has been designed after a thorough study of the country's large and modern lacquer plants; it is to be one of the most efficient units of its kind, it is stated.

The building is to cover a ground area of 50 by 100 feet and will be of fireproof brick and steel construction. The company's present plant is being entirely remodeled for use as an office, laboratory, recreation room and shipping department. Straight-line production will be carried on in the new plant. There will be eight 10,000-gallon storage tanks underground for raw materials, each equipped with pump system.

Business Reports in Brief

Capital Brass Works, Ltd., Ottawa, Ont., Can., was destroyed by fire at a loss of $75,000.

Taunton and New Bedford Copper Company, New Bedford, Mass., has awarded contract for a one and two-story addition.

Springfield Bronze Company, Springfield, Mass., has changed its name to the Springfield Bronze and Aluminum Company.

International Silver Company, 48 State Street, Meriden, Conn., awarded contract for the construction of a two-story factory.

San Francisco Galvanizing Works, San Francisco, Cal., has awarded contract for extensions and improvements to cost about $25,000.

Platt Bros. and Company, Waterbury, Conn., awarded contract for a one-story, 75 x 140 ft. brass rolling mill. Estimated cost $42,000.

Haynes Stellite Company, Kokomo, Ind., manufacturer of alloys, tools, etc., has awarded several contracts in connection with its new plant addition.

Baltimore Copper Smelting and Refining Company, Canton, Baltimore, Md., has awarded contract for a one-story addition to cost about $35,000 with equipment.

Lunkenheimer Company, Carthage, Ohio, manufacturer of valves, steam specialties, etc., has awarded general contract for a one-story addition, to cost about $30,000 with equipment.

Cochrane Brass Foundry, Boll and Spahn Avenues, York, Pa., is completing construction of a new one-story foundry unit, 40 x 60 ft., to cost more than $6,000 with equipment.

Detroit Die Casting Company, Detroit, Mich., has taken bids for the construction of a one and two-story plant and office building to cost about $75,000. **C. H. Davis** is president.

Bass Brothers, 1231 Thirty-first Street, Milwaukee, Wis., refiners and dealers in scrap metal, have started construction of a two-story addition, 50 x 135 ft., costing about $30,000 with equipment.

Chase Brass and Copper Company, Waterbury, Conn., has arranged for a new factory branch and distributing plant at 25 Ellicott Street, Buffalo, N. Y. **F. C. Kaufmann** will be local manager in charge.

Tiffany Aluminum Products Company, St. Louis, Mo., has acquired a new plant building at Branch and Buchanan Streets and has moved its foundry and offices from the former location. **Lee Rosenberg** is president.

Kirchhof Patent Company, Newark, N. J., manufacturer of tin toys and other metal novelties has removed its plant from 30 Stirling Street to a larger factory at 60-64 Union Street, where production will be expanded.

Thomson Products, Inc., Cleveland, Ohio, is establishing a branch plant in St. Catherines, Ont., Can., for the manufacture of valves and other products. The company is building a two-story factory with a space of 25,000 sq. ft.

Capitol Stampings Company, 516 W. McCarty Street, Indianapolis, Ind., a new organization, will engage in the manufacture of light stampings, tool and die work. It will be under the management of **C. R. Swenson,** formerly connected with Oakes Manufacturing Company.

Service Foundry Company, New Orleans, La., recently incorporated to manufacture gray iron, bronze and aluminum castings for the jobbing trade, has started production. It has a new plant, 125 x 127 feet, at 1153 S. Cedar Street. **M. J. Rabe** is in charge.

Leader Specialty Company, 515 E. Walnut Street, Indianapolis, Ind., manufacturer of plumbing equipment and supplies, has asked bids on general contract for a one-story plant, 45 x 112 ft., to cost about $25,000 with equipment. **C. J. Mick** is general manager.

Time-O-Stat Controls Company, Elkhart, Ind., will soon use 79,000 sq. ft. of additional floor space. The plant which manufactures heat regulating devices, is a consolidation of several scattered factories. The company states that further additions will be necessary in the near future.

Kellam and Moore Foundry Company, Park Street, High Point, N. C., has started production of brass and aluminum castings, also gray iron, in the plant it has leased from the Industrial Electric and Machine Company. The output is for the jobbing trade. **C. E. Kellam** is in charge.

Inca Manufacturing Corporation, Fort Wayne, Ind., recently organized, to manufacture copper wire products for radio, electric and other service, has work nearing completion on initial unit of a new plant, one story, 20 x 300 ft., to cost more than $100,000. **G. A. Jacobs** is president.

Motor-Car Ventilator Corporation, Suffolk, Va., manufacturer of vacuum ventilating devices, does not yet have their new brass and aluminum foundry under construction. They will build a new foundry in the near future which will be 60 x 70 feet. The company is in the market for the necessary equipment.

B. D. and **H. D. Adams,** owners of Adams Manufacturing Company, Galesburg, Ill., have purchased **Meyer-Foley Company,** same city, and will consolidate operations. Automotive accelerators, footrests, pressed steel pulleys, metal stampings for washing machines and similar special machinery are manufactured.

Columbia Metal Stamping and Die Company, Cleveland, Ohio, manufacturer of parts for automobiles, radios and electrical appliances, has purchased a plant now being constructed at E. 116th Street and Harvard Avenue. About $50,000 will be expended in new equipment for the plant, which will add 21,000 sq. ft. to floor space of the company. **F. C. Koch** is president.

The **Pines Winterfront Company,** Chicago, Ill., has moved its "built-in" department to the new plant at Cicero Avenue and Division Street. The new plant provides 200,000 sq. ft. of floor space on two floors. Presses and other heavy machinery are on the first floor, and enameling, plating and assembling are done on the second floor. Engineering and general offices and the experimental laboratory are also on this floor.

Midvale Company, Nicetown, Philadelphia, Pa., has purchased the **Chrome Alloy Products, Inc.,** Conshohocken, Pa., manufacturers of chrome and chrome nickel alloy castings. The company has obtained the exclusive right to manufacture in the United States patented compositions of chromium and nickel with other alloys held by **Commentry-Fourchambault et Decazeville,** Paris, France, and also is licensed to produce certain alloy steels developed by Sir Robert Hatfield. **T. Holland Nelson** has been retained as consulting engineer and in an advisory capacity.

New Companies

Abwirth, Inc., Passaic, N. J., has been incorporated for $10,000, to manufacture jewelry.

Hubley Manufacturing Company, Lancaster, Pa., has been incorporated with $5,000 capital to manufacture and deal in metal toys, castings and metal products. **J. T. Breneman,** R. D. No. 6, Lancaster, is treasurer.

M. B. Whitney, 1734 No. Fifth Street, Philadelphia, Pa., and associates, have organized the **Nicetown Manufacturing Company,** to establish a plant in the Nicetown district for the manufacture of pressed, stamped and drawn metal products, also die-stamped specialties. **E. L. Davis** is interested in the new organization.

R. S. Holland, Milwaukee, Wis., formerly connected with **National City Products Company,** same city, manufacturer of metal castings, etc., is organizing company to establish a plant at Fort Wayne, Ind., for the production of brass, bronze, aluminum and similar castings. **J. B. Wiles** is interested in the project and has detailed information.

High Point Machine and Manufacturing Company, High Point, N. C., has been organized with capital of $100,000 to do a general machine shop and foundry business on site formerly occupied by **High Point Machine Works.** The company will manufacture aluminum, bronze, gray iron and boiler room castings and a few special machine, including a line of clamps for furniture factories.

Trade Publications

Erection Service, Refrigeration. Armstrong Cork and Insulation Company, Lancaster, Pa. Leaflet on corkboard insulation.

Buffalo Wetboy Unit Heater. Buffalo Forge Company, Buffalo, N. Y. Leaflet on an air-washing and humidifying unit heater.

Correct Protection Against Fire. American-LaFrance and Foamite Corporation, Elmira, N. Y. Fire extinguishing devices.

Forging a Differential Side Gear. The National Machinery Company, Tiffin, Ohio. National Forging Machine Talk No. 70. Illustrated circular.

The Quarter Century Mark. Pangborn Corporation, Hagerstown, Md. Leaflet on the twenty-fifth anniversary of this large manufacturer of sand blasting equipment.

Industrial Air Heaters. Gehnrich Oven Company, Inc., Long Island City, N. Y. Air heating apparatus for low temperature industrial baking and drying operations.

Stable-Arc Welder. The Lincoln Electric Company, Cleveland, Ohio. Leaflets on this company's 300-ampere welders of various types, with complete specifications.

Spectrographic Outfits for Metallurgical Analyses. Adam Hilger, Ltd., 21 Rochester Place, Camden Road, London, N. W. 1, England. A guide to the choice of spectrographic apparatus.

Green Chain Grate Stoker. Combustion Engineering Corporation, 200 Madison Avenue, New York City. Catalog describing the Green natural draft stoker for steam boilers. Illustrated.

The Handy Book of Silver Solders. Handy and Harman, 57 William Street, New York City. Illustrated booklet on hard soldering, explaining uses of silver solders and methods of application.

Truck-Type Switchboards. Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa. Completely assembled, tested and inspected switching apparatus, factory built, ready for plant use.

Airplane Fuselage Welding. The Linde Air Products Company, 30 East 42nd Street, New York City. Illustrated 12-page pamphlet outlining a course in welding duralumin and other light alloys used in aircraft.

Rite-Speed Electric Polishing and Buffing Lathes. Hammond Machinery Builders, Inc. (formerly Hill-Curts Company) Kalamazoo, Mich. Bulletin No. 10, illustrated pamphlet describing a number of new models.

Horse Head Zinc in Die Castings. The New Jersey Zinc Company, 160 Front Street, New York City. Admirably illustrated booklet showing many examples of die cast products and explaining the use of zinc and zinc alloys in them.

The Fuerst-Friedman Company, 1292 East 53rd Street, Cleveland, Ohio. **Bulletin 37,** a catalog of motors, generators, grinders, compressors, pumps, cranes and miscellaneous other rebuilt machinery. Forty-eight pages illustrated.

The Ferro Enamel Supply Company, Cleveland, Ohio, offers the following, gratis: "Brushings," a monthly organ edited by William Feather; "Burning Facts," "Where One Outweighs Ten," "Saving $80 a Day," and "When the Committee Decides."

Standardized Buffing Compositions. Frederic B. Stevens, Inc., Detroit, Mich. Pamphlet on a variety of compositions for chromium plate and other metallic finishes. Also, "Doctor Stevens Emergency Service," leaflet on plumbago, core compounds and wash, etc.

General Electric Company, Schenectady, N. Y., publications: Electric Gasoline Gauge for Aircraft; List of Buildings and Bridges Constructed by Welding Steel; Constant-Potential Arc-Welding Sets; Pressure Governor; Motor Controllers; Automatic Welding Head and Control Magnetic Controllers; Conveyor Furnace Type RRT, with mesh belt, for quantity heat treatment of small parts at temperatures up to 1650° F.; Luminous Harmony in the Home; Looking Ahead in Aviation Lighting; Floodlighting; Electric Light on the Farm and in Rural Districts.

Hanson-Munning Polishing and Plating Equipment and Supplies. Hanson-Van Winkle-Munning Company, Matawan, N. J. Catalog No. 109, showing the company's complete line of products, well known in the plating and finishing industry. The new book is up to the company's usual standard, being beautifully printed and illustrated. It is divided in four sections, covering buffing and polishing supplies, plating supplies, plating equipment, and buffing and polishing equipment. The company supplies every manner of equipment and supplies, including generators and large full automatic conveyors for electroplating, galvanizing, etc. The catalog just issued has 128 pages and is adequately indexed, making it a reference work worthy of a place in every plant.

Metal Prices, December 16, 1929

NEW METALS

Copper: Lake, 18.125. Electrolytic, 17.75. Casting, 17.00.
Zinc: Prime Western, 5.50. Brass Special, 5.60.
Tin: Straits, 41.75. Pig, 90%, 40.875.
Lead: 6.10. **Aluminum,** 24.30. **Antimony,** 8.40.
Nickel: Ingot, 35. Shot, 36. Elec., 35. Pellets, 40.
Quicksilver: flask, 75 lbs., $124. **Bismuth,** $1.70.
Cadmium, 95. **Cobalt,** 97%, $2.60. **Silver,** oz., Troy, 49.00.
Gold: oz., Troy, $20.67. **Platinum,** oz., Troy, $61.00.

INGOT METALS AND ALLOYS

Brass Ingots, Yellow	12¼to13½
Brass Ingots, Red	15½to16½
Bronze Ingots	16½to19
Casting Aluminum Alloys	21 to24
Manganese Bronze Castings	27 to39
Manganese Bronze Ingots	13½to19
Manganese Bronze Forgings	35 to43
Manganese Copper, 30%	28 to40
Monel Metal Shot	28
Monel Metal Blocks	28
Parsons Manganese Bronze Ingots	16½to19¾
Phosphor Bronze	17 to21
Phosphor Copper, guaranteed 15%	20½to24
Phosphor Copper, guaranteed 10%	20 to23½
Phosphor Tin, no guarantee	45 to60
Silicon Copper, 10%, according to quantity	25 to35

OLD METALS

Buying Prices		Selling Prices
14 to14½	Heavy Cut Copper	15 to15½
13½to13¾	Copper Wire, mixed	14½to14¾
12 to12¼	Light Copper	13 to13¼
11 to11¼	Heavy Machine Composition	12 to12¼
7¾to 8	Heavy Brass	8¾to 9
6¼to 6¾	Light Brass	7¼to 7¾
11 to11¼	No. 1 Composition	12 to12¼
10 to10¼	Composition Turnings	11 to11¼
4⅜to 4⅞	Heavy Lead	5⅜to 5⅞
2½to 3	Zinc Scrap	3½to 4
15½to16	New Aluminum Clips	19½to20
10 to10¼	Scrap Aluminum, cast alloyed	15 to15¼
10½to11	Scrap Aluminum sheet (new)	13 to14
24 to26	No. 1 Pewter	29 to30
20 to21	Old Nickel Anodes	22 to23
20 to23	Old Nickel	22 to25

Wrought Metals and Alloys

COPPER SHEET

Mill shipment (hot rolled) .....27¾ to 28¾c. net base
From Stock .....28¾ to 29¾c. net base

BARE COPPER WIRE

19⅝c. to 19⅞c. net base, in carload lots.

COPPER SEAMLESS TUBING

29¼c. to 30¼c. net base.

SOLDERING COPPERS

300 lbs. and over in one order .....26¼c. net base
100 lbs. to 200 lbs. in one order .....26¾c. net base

ZINC SHEET

Duty on sheet, 2c. per lb. Cents per lb.
Carload lots, standard sizes and gauges, at mill, less 7 per cent discount .....10.50 net base
Casks, jobbbers' price .....10.75 net base
Open casks, jobbers' price .....11.25 to 11.75 net base

ALUMINUM SHEET AND COIL

Aluminum sheet, 18 ga., base, ton lots, per lb. 33.30
Aluminum coils, 24 ga., base, price 31.00

ROLLED NICKEL SHEET AND ROD

Net Base Prices

Cold Drawn Rods	53c.	Cold Rolled Sheet	60c.
Hot Rolled Rods	45c.	Full Finished Sheet	52c.

BLOCK TIN SHEET

Block Tin Sheet—18" wide or less. No. 26 B. & S. Gauge or thicker, 100 lbs. or more 10½c. over Pig Tin; 50 to 100 lbs., 15c. over; 25 to 50 lbs., 17c. over; less than 25 lbs., 25c. over.

SILVER SHEET

Rolled sterling silver 51c., Troy oz., upward according to quantity.

BRASS MATERIAL—MILL SHIPMENTS

In effect April 16, 1929.
To customers who buy 5,000 lbs. or more in one order.

	Net base per lb. High Brass	Low Brass	Bronze
Sheet	$0.23¼	$0.25	$0.26¼
Wire	.23¾	.25½	.26¾
Rod	.21¼	.25¾	.27
Brazed tubing	.30⅞	....	.35⅞
Open seam tubing	.31¼	....	.34¼
Angles and channels	.31¼	....	.34¼

BRASS SEAMLESS TUBING

28¼c. to 29¼c. net base.

TOBIN BRONZE AND MUNTZ METAL

Tobin Bronze Rod ..... .25¾c. net base
Muntz or Yellow Metal Sheathing (14"x48")... .24c. net base
Muntz or Yellow Rectangular sheet other Sheathing ..... .25c. net base
Muntz or Yellow Metal Rod ..... .22¾c. net base
Above are for 100 lbs. or more in one order.

NICKEL SILVER (NICKELENE)

Net Base Prices

Grade "A" Sheet Metal		Wire and Rod	
10% Quality	31⅜c.	10% Quality	34⅛c.
15% Quality	33c.	15% Quality	37¾c.
18% Quality	34¼c.	18% Quality	41c.

MONEL METAL SHEET AND ROD

Hot Rolled Rods (base).	35	Full Finished Sheets (base)	42
Cold Drawn Rods (base)	40	Cold Rolled Sheets (base)..	50

BRITANNIA METAL SHEET

No. 1 Britannia—18" wide or less, No. 26 B. & S. Gauge or thicker, 500 lbs. or over, 8c. over N. Y. tin. price; 100 lbs. to 500 lbs., 10c. over; 50 to 100 lbs., 15c. over; 25 to 50 lbs., 20c. over; less than 25 lbs., 25c. over. Prices f. o. b. mill.

Supply Prices, December 16, 1929

ANODES

Copper: Cast	28c.	per lb.
Rolled, oval	27c.	per lb.
Rolled, sheets, trimmed	27¾c.	per lb.
Brass: Cast	27c.	per lb.
Zinc: Cast	12⅞c.	per lb.

Nickel: 90-92%	45c.	per lb.
95-97%	47c.	per lb.
99%	49c.	per lb.

Silver: Rolled silver anodes .999 fine are quoted from 52½c. per Troy ounce upward, depending upon quantity.

FELT POLISHING WHEELS WHITE SPANISH

Diameter	Thickness	Under 100 lbs.	100 to 200 lbs.	Over 200 lbs.
10-12-14 & 16"	1" to 3"	$3.00/lb.	$2.75/lb.	$2.65/lb.
6-8 & over 16	1 to 3	3.10	2.85	2.75
6 to 24	Under ½	4.25	4.00	3.90
6 to 24	½ to 1	4.00	3.75	3.65
6 to 24	Over 3	3.40	3.15	3.05
4 up to 6	¼ to 3	4.85	4.85	4.85
4 up to 6	Over 3	5.25	5.25	5.25
Under 4	¼ to 3	5.45	5.45	5.45
Under 4	Over 3	5.85	5.85	5.85

Grey Mexican Wheel deduct 10c per lb. from White Spanish prices

COTTON BUFFS

Full Disc Open buffs, per 100 sections.

12" 20 ply 64/68 Unbleached	$28.27 to $28.30
14" 20 ply 64/68 Unbleached	36.45 to 37.34
12" 20 ply 80/92 Unbleached	31.25 to 34.16
14" 20 ply 80/92 Unbleached	42.40 to 46.09
12" 20 ply 84/92 Unbleached	36.60 to 42.50
14" 20 ply 84/92 Unbleached	49.60 to 57.43
12" 20 ply 80/84 Unbleached	38.35 to 39.37
14" 20 ply 80/84 Unbleached	52.00 to 53.12
Sewed Pieced Buffs, per lb., bleached	52c to 71c.

CHEMICALS

These are manufacturers' quantity prices and based on delivery from New York City.

Acetone	lb.	.11-.18
Acid—Boric (Boracic) Crystals	lb.	.08½
Chromic 100 to 400 lb. drums	lb.	.19-.21
Hydrochloric (Muriatic) Tech., 20°, Carboys	lb.	.02
Hydrochloric, C. P., 20 deg., carboys	lb.	.06
Hydrofluoric, 30% bbls.	lb.	.08
Nitric, 36 deg., carboys	lb.	.06
Nitric, 42 deg., carboys	lb.	.07
Sulphuric, 66 deg., carboys	lb.	.02
Alcohol—Butyl	lb.	.16¾-.21¼
Denatured, drums	gal.	.52-.60
Alum—Lump, Barrels	lb.	.03¼
Powdered, Barrels	lb.	.039
Aluminum chloride solution in carboys	lb.	.06½
Ammonium—Sulphate, tech., bbls.	lb.	3.3
Sulphocyanide	lb.	.65
Arsenic, white, kegs	lb.	.05
Asphaltum	lb.	.35
Benzol, pure	gal.	.60
Borax Crystals (Sodium Biborate), bbls.	lb.	.04½
Calcium Carbonate (Precipitated Chalk)	lb.	.04
Carbon Bisulphide, Drums	lb.	.06
Chrome Green, bbls.	lb.	.25
Chromic Sulphate	lb.	.30-.40
Copper—Acetate (Verdigris)	lb.	.23
Carbonate, bbls.	lb.	.21½
Cyanide (100 lb. kegs)	lb.	.45
Sulphate, bbls.	lb.	6.7
Cream of Tartar Crystals (Potassium Bitartrate)	lb.	.27
Crocus	lb.	.15
Dextrin	lb.	.05-.08
Emery Flour	lb.	.06
Flint, powdered	ton	$30.00
Fluor-spar (Calcic fluoride)	ton	$70.00
Fusel Oil	gal.	$4.45
Gold chloride	oz.	$12.00
Gum—Sandarac	lb.	.26
Shellac	lb.	.59-.61
Iron Sulphate (Copperas), bbl.	lb.	.01½
Lacquer Solvents	gal.	.85
Lead Acetate (Sugar of Lead)	lb.	.13¼
Yellow Oxide (Litharge)	lb.	.12½
Mercury Bichloride (Corrosive Sublimate)	lb.	$1.58
Nickel—Carbonate, dry, bbls.	lb.	.35
Chloride, bbls.	lb.	.20
Salts, single, 300 lb. bbls.	lb.	.12½-.13
Salts, double, 425 lb. bbls.	lb.	.12½-.13
Paraffin	lb.	.05-.06
Phosphorus——Duty free, according to quantity	lb.	.35-.40
Potash, Caustic Electrolytic 88-92% broken, drums	lb.	.093
Potassium Bichromate, casks (crystals)	lb.	.09¼
Carbonate, 96-98%	lb.	.06¾-.07
Cyanide, 165 lb. cases, 94-96%	lb.	.57½
Pumice, ground, bbls.	lb.	.02½
Quartz, powdered	ton	$30.00
Rosin, bbls.	lb.	.04½
Rouge, nickel, 100 lb. lots	lb.	.25
Silver and Gold	lb.	.65
Sal Ammoniac (Ammonium Chloride) in casks	lb.	.05½
Silver Chloride, dry, 100 oz. lots	oz.	.40¼
Cyanide (fluctuating)	oz.	.49½
Nitrate, 100 ounce lots	oz.	.35
Soda Ash, 58%, bbls.	lb.	.02½
Sodium—Cyanide, 96 to 98%, 100 lbs.	lb.	.18
Hyposulphite, kegs	lb.	04
Nitrate, tech., bbls.	lb.	.04¾
Phosphate, tech., bbls.	lb.	.03¾
Silicate (Water Glass), bbls.	lb.	.02
Sulpho Cyanide	lb.	.32½
Sulphur (Brimstone), bbls.	lb.	.02
Tin Chloride, 100 lb. kegs	lb.	.34
Tripoli, Powdered	lb.	.03
Wax—Bees, white, ref. bleached	lb.	.60
Yellow, No. 1	lb.	.45
Whiting, Bolted	lb.	.02½-.06
Zinc Carbonate, bbls.	lb.	.11
Chloride, casks	lb.	.06¾
Cyanide (100 lb. kegs)	lb.	.41
Sulphate, bbls.	lb.	.03½